SUTRON 8210/8200A

DATA RECORDER

OPERATIONS MANUAL

Sutron Part No. 8800-1059
Revision D

21300 Ridgetop Circle
Sterling,Virginia 20166
(703) 406-2800
Fax: (703) 406-2801

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Using This Manual

This manual describes the operation and maintenance of the Sutron 8200 family of data recorders/transmitters. It is designed to be of use to both beginning and experienced users. The manual describes the use of all models of the 8200A and 8210 data recorder/transmitters running software versions 4.0 and above both with and without telemetry. The manual comes with a diskette that contains programs useful in the setup and operation of 8200s. Instructions on using the software is provided in Appendix E.

> In this manual, 8200 (or 8200s) refers to both the 8200A and 8210. When necessary to describe the features or differences of a particular model, the specific model number (8210 or 8200A) is used. Because all models are described, you should be aware that some information may not apply to your particular 8200. Do not use this manual as a reference for operating 8200s or 8200As running software versions prior to 4.0.

There are twelve chapters in this manual. These twelve chapters introduce you to the 8200 and present the basics to get you started using the 8200. Chapters 1 through 3 should be read by anyone planning to use the 8200. Chapter 4 contains a detailed reference of all the 8200 menus and commands. You should not try to read this chapter start to finish -- it is intended as a reference. The remaining chapters teach you how to use the 8200 covering topics such as hooking up sensors, common setups, installation, retrieving data and others. These chapters have many practical examples of using the 8200 in the field. Of particular note is Chapter 7 which contains many examples on how to use the 8200 in particular situations.

The chapters are presented in the following order:

1. Introduction
2. Unpacking and Initialization
3. Getting to know the 8200A and 8210
4. Menu Tree Reference
5. Quick Setup
6. Hooking up sensors
7. How To ...
8. Installation
9. Retrieving Your Data
10. Tiny BASIC
11. Maintenance and Service
12. Troubleshooting

Specifications for the 8200A and 8210 are contained in Appendix A. Appendix B contains blank setup sheets. Appendix C contains assembly drawings and bills of materials for the different model 8200s. Appendix D contains a description of the GOES transmission format. Appendix E contains information on the programs provided on the diskette that comes with this manual. These programs are useful in the setup and operation of 8200s. Appendix F contains information on Sutron Standard Protocol (SSP), the protocol used by 8200 in most LOS radio and telephone communications.

Chapter 1

Introduction

This chapter introduces you to the Sutron Model 8200 family of data recorders and transmitters and presents the features and capabilities that have made the 8200 the nucleus of data collection systems throughout the world.

8200 Family Overview

The Sutron 8200 family of data collection products is specifically designed to meet the wide variety of remote data collection needs of the hydrologic and meteorologic communities. These needs may range from simple data recording to transmission via satellite or other telemetry links.

Each 8200 unit has a range of inputs designed to support the most common data collection applications. These include:

- Water Level
- Rainfall
- Temperature/pressure
- Relative Humidity
- Wind speed and direction

The overall 8200 design utilizes CMOS and low-power circuitry to achieve long-life battery operation and provide a rugged system for unattended field operation in extreme environments. For even more durability, each 8200 is tested to operate over the -40°C to +60°C temperature extremes expected in remote environments. Full EMI and transient protection are built into each input.

The 8200 family is divided into two basic units: the 8200A and the 8210. The 8210 is a third generation 8200 adding features most asked for by customers. The 8210 datalogger retains and builds on all the features and programming structure of the 8200A datalogger. Users can expect the same ease of programming by front panel, flexible setup, and telemetry options. Enhancements featured in the 8210 include:

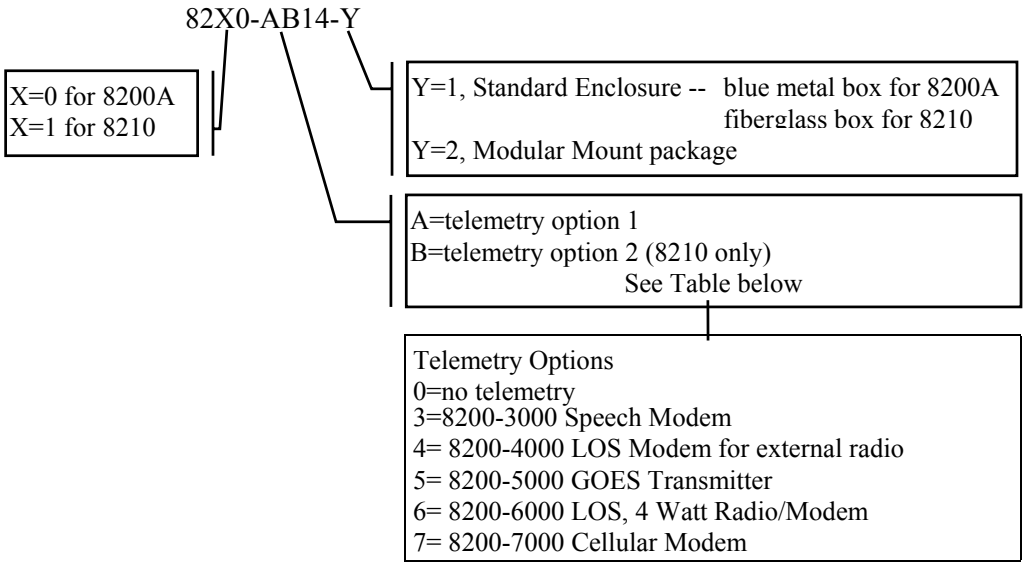
- Dual communications now supported in one unit
- PCMCIA memory card slot for data or programming storage
- True industry standard RS-485 port
- 20 Digital input/output lines for SCADA or other control applications
- Internal auxiliary RS-232 port
- Dedicated SDI-12 port with three wire terminal connection
- Solar panel battery regulator current increased to 1.25 amps to support larger solar panels
- Dedicated external RS-232 serial port for programming and data retrieval.

Both units (8210 and 8200A) can accommodate optional telemetry modules.

- telephone modem,
- telephone modem with speech synthesis,
- GOES radio transmitter,
- radio modem with internal radio,
- radio modem for external radio
- METEOSAT radio transmitter
- INSAT radio transmitter.

Model Numbers

The full model number for the 8200 specifies the type of 8200 ordered as well as the telemetry options selected. The general format of the model number is



The following are some examples of models that can be ordered:

8200-0014-1	8200A, no telemetry
8200-5014-1	8200A with GOES transmitter
8210-5014-1	8210 with GOES transmitter
8210-5014-2	8210 with GOES transmitter, -modular mount
8210-5314-1	8210 with Speech Modem and GOES Transmitter
8210-3614-1	8210 with Speech Modem and LOS, 4 Watt Radio/Modem

Note: the 8200A can have only one telemetry option.

Wide Range of Applications

8200s may be used to collect basic information from sensors to support a variety of different systems. Typical applications may include:

- Flood Warning
- Weather Stations
- General stage and precipitation networks
- Dam safety monitoring
- Store-and-forward to Sutron 9000 series SCADA systems
- On-site recording of many kinds of digital or analog data
- Irrigation control

Inputs Specifically Designed for HYDROMET Applications

The 8200 family was designed from the ground up for the low cost acquisition of data from a wide assortment of sensors. By limiting the number of inputs and by specifically tailoring the design towards measurement of precipitation, wind speed/direction, and water level, Sutron has provided an economical way to obtain needed information.

Simple Setup

The 8200 is based on a powerful 16-bit microprocessor, allowing users to set up the 8200 in any one of several easy ways:

- Front Panel -- setup information can be entered using the 6 keys built into the front panel. The keypad is used to select or modify items in a variety of setup menus.
- Portable PC -- Those users with access to a portable PC may find it easier to set up the 8200 through the unit's serial port by using Sutron's TS8210 PC-based software or standard commercial communications packages (such as PROCOMM).
- Remote PC -- 8200s with telephone and LOS modems can be set up remotely by means of a computer terminal or PC.

Easy Wiring

To further ease the process of setup, the 8200s were designed to be easy to hook up in the field. All connections are made through a terminal strip. For the 8200, the terminal strip is on the front panel. For the 8210, the terminal strip is either on the side panel or inside the enclosure depending on the enclosure selected. When all wiring is complete, the entire terminal strip can be unplugged. This feature greatly simplifies unit swapping should the occasion arise.

Sealed Units

8200s are designed to operate without additional packaging. They can be placed on a shelf in a gauge house or weather station with no additional protection. Custom NEMA-4 and IP66 housings are available for stand-alone outside applications or where all wiring must be in conduits. The -2 version of the 8210 is a modular mount version. This version is designed to easily fit into custom enclosures.

Large Secure Memory

When fully configured, each 8200 system can control up to 384KB of battery backed-up RAM (Data Storage/ Recording), 256KB of EPROM (Operating System), and 6KB of EEROM (Setup Information/Passwords & Security). The battery backed-up memory is used as a "log" for recording data. The standard 128KB memory can hold over 60,000

readings which translates into nearly two years of data for one sensor recorded every 15 minutes.

The memory system uses Lithium batteries for long shelf life (2 years minimum), and long safe data storage (1 year minimum).

Easily Networked

The 8200s were designed from the start to work closely with other Sutron data collection and processing equipment. Telemetry-equipped units communicate in Sutron Standard Protocol thus allowing them to be used to relay data to Sutron 9000 Remote Telemetry Units which can then act as repeaters or data processors. The 8200s can also "talk" directly to Sutron PC or VAX base stations.

Chapter 2

Unpacking and Initialization

This chapter provides information to help you unpack the 8200 and start using it. You will learn how to hook a battery to an 8200 and how to run a quick test to make sure it is operating properly.

Unpacking

- Carefully remove the 8200 from the shipping container.
- Save the container and packing materials as they may be used to transport the 8200 to the site or for shipping the unit back to the factory.

> Note: If you want to return a unit to the factory, first fill out the Product Return Sheet located at the back of this manual and then call the factory (703 406-2800) for an RMA number. This procedure will help us to handle your equipment in the most efficient manner.

Initialization

All units have been initialized at the factory. Factory initialization consists of:

- installing the Lithium Battery jumper to maintain RAM and the internal clock
- installing the internal battery (standard and speech/modem models only) and
- applying power to the 8200 with the ◄ and ► keys pressed to initiate an INITIALIZATION.

This last step clears out the databases and autosizes the available memory. For instructions on doing this initialization yourself, please refer to Chapter 11, page 11-11.

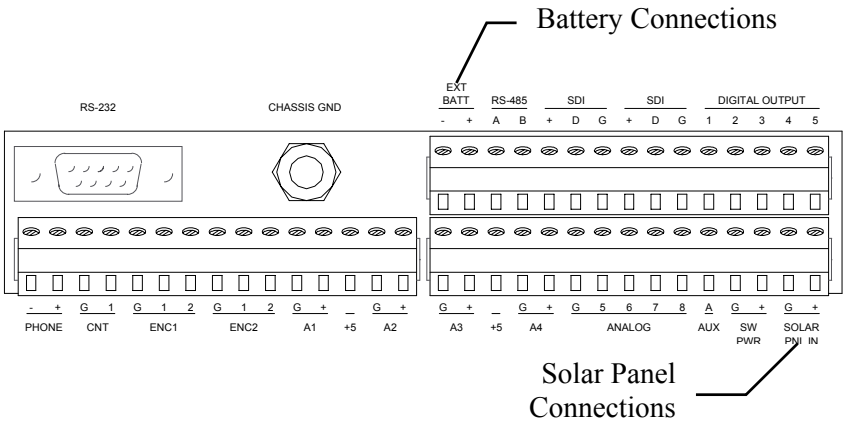
Connecting the Main Battery

The 8200 is designed to run using power from a main battery. Some model 8200s come with a main 12VDC battery already installed. These models are the basic 8200s (8200-0014, 8210-0014) and 8200s with only a speech modem installed (8200-3014, 8210-3014). The battery is a 12V, 6 amp hour, rechargeable battery mounted on the back panel. All other models require an external battery.

8210 -- The main battery connects to the protection/termination board installed in the 8210. The protection/termination board has several separate connections for the battery that are connected together internally. One set of connections (J6) accommodates a 2 pin connector and the other set of connections is for use with bare wires. A picture of the connections is shown on the following page.

If your 8210 comes with an internal battery, the cable with connector is ready to plug into the J6 receptacle on the protection/termination board. If you have your own battery to connect to the 8210, use your own cable and connect it to the terminal strip as shown on the following page. Use 18AWG wire or less to minimize the voltage drop in the cable.

The battery connections are marked EXT BATT G and +. Observe polarity with the G as ground and + as the 12V positive. Be careful to disconnect the cable from the battery while making connections. Connecting the battery in reverse, will not damage the 8210. Note that if a GOES Transmitter is installed, the fuse located in the power cable will blow. Do not connect more than one battery to the 8210 as both batteries will not charge equally.

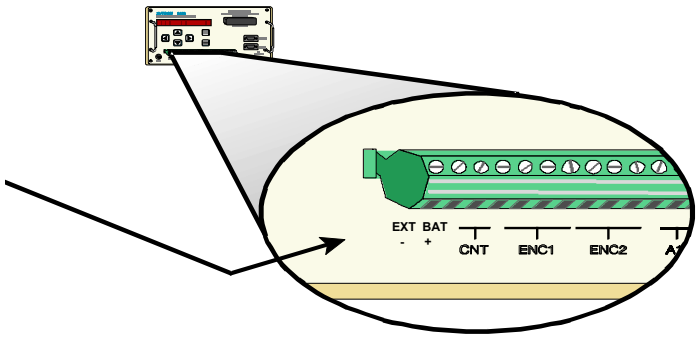


After you have connected the power source appropriate to your model, you may notice the 8200 display turn on, then go out after a few minutes. This is a normal function designed to conserve battery power and lengthen battery life.

8200A -- If the 8200A comes with an internal battery, the battery is already connected. To switch the battery ON, press the rubber membrane cover on the rear of the 8200A. This switch turns on or off battery power to the 8200A each time it is pressed. Press it once and the display should light up. Press it again, and the battery is disconnected. This is not to be confused with the ON OFF button on the front panel of the 8200. The ON OFF button is used solely for turning the front panel display on or off. It does not connect/disconnect the system power.

If the 8200A has the label EXT BAT - + on the far left side of the terminal strip, it is wired for an external battery. Connect a single 12V battery to the terminal strip observing proper polarity. We recommend that you use an 18 gauge wire or less to minimize voltage drops that may occur through the cable. Connecting the battery in reverse will blow an internal fuse on the 8200A.

Warning: If you connect the battery incorrectly, you could blow one of the internal fuses. Refer to page 11-4 for instructions on replacing fuses. The arrow indicates the location of the power supply inputs



After you have connected the power source appropriate to your model, you may notice the 8200 display turn on, then go out after a few minutes. This is a normal function designed to conserve battery power and lengthen battery life.

Connecting the Charging Voltage

The next step is to connect a charging voltage to the 8200. The 8200 can accomodate a charging voltage from 13 to 18 volts that is common from a solar panel or DC power supply. On the 8210, connect the charging voltage to the two pins labeled SOLAR PANEL G +. On the 8200A, connect the charging voltage to the two pins labeled PWR IN, G and + on the far right of the terminal strip. This voltage passes through an internal regulator that keeps the battery fully charged. The internal regulator is limited to 1.25 amp (3/4 amp on 8200A). Without a charging voltage, the 8200 will run using the power from the main battery. When the battery voltage drops, the 8200 may stop operating until it is charged again.
Remember that if no internal or external battery is installed, the use of the solar panel alone will not allow the 8210 to power on. If this application is desired, change the jumper J7 to position 1-2 on the interconnect board as described in the link table in Chapter 11.

Quick Test

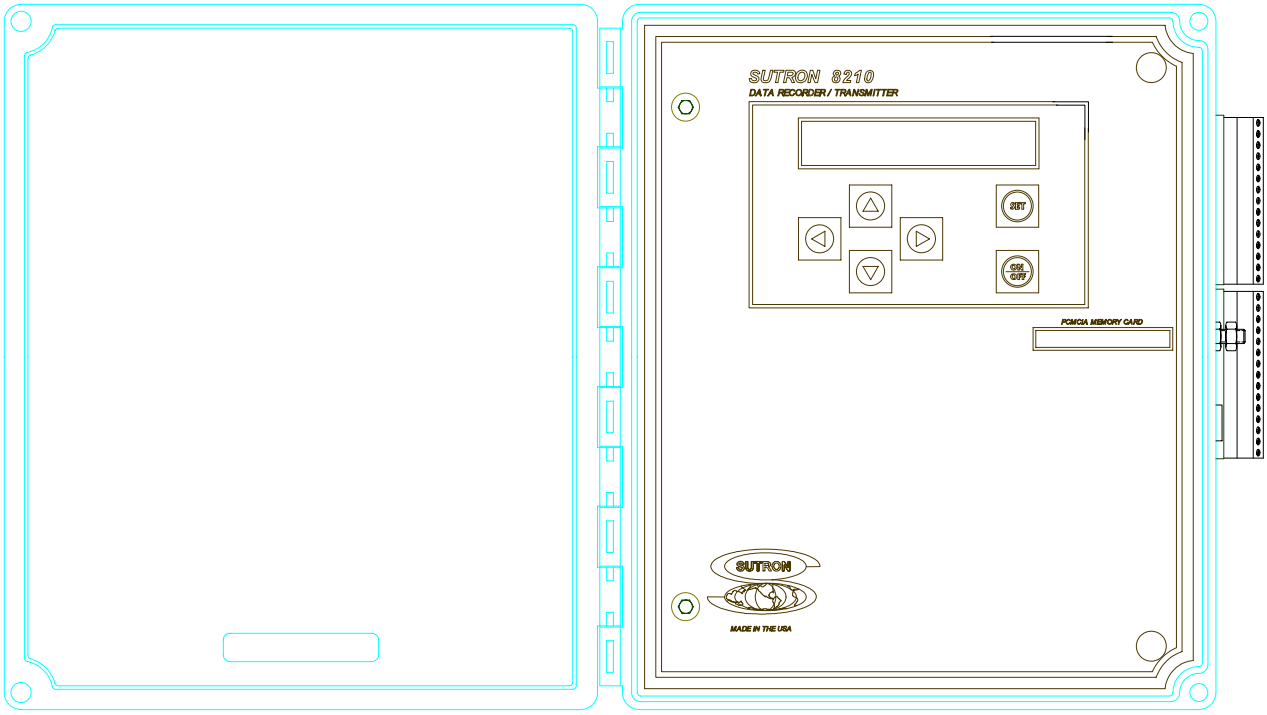
The 8200 is running whenever the battery is connected. To verify that the 8200 is running, press ON/OFF on the front panel. The 8200 display should light up with a message displaying the version of the software. If not, check your connections. If you have an 8200A with internal battery,try pressing the power switch at the back of the enclosure. If the 8200 still does not light up the display, consult the Troubleshooting Guide in Chapter 12, page 1. Depending on how your particular unit has been set up, the display may remain on, or turn off after a brief period.

Chapter 3

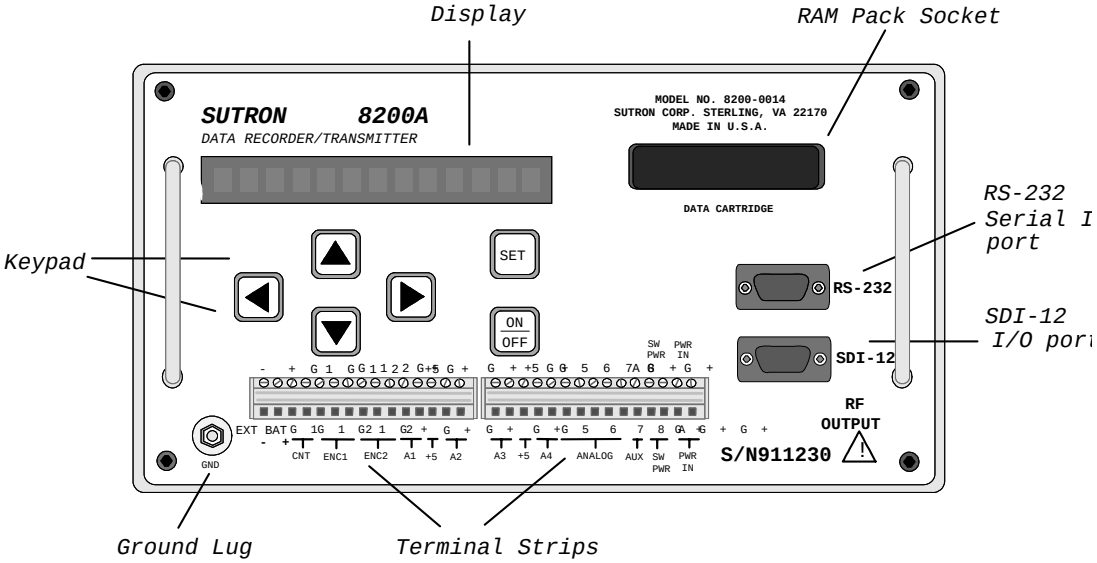
Getting To Know The 8200

This chapter describes in detail the 8200 front panel (including connections, controls and displays) and the menus that you will use to set up and operate the 8200. Complete information is given on how to operate the 8200 from the front panel or a PC.

8200 Front Panel



8210 Front Panel (-1 version shown)



8200A for external power
(Battery connects to EXT BAT, Solar Panel to PWR IN)

The Front Panel

The front control panel provides a built-in way to operate the 8200. As you learn how to enter or select values and move around the menu tree using the control panel keys, use of the 8200 will be greatly simplified and will soon become intuitive. Another, more convenient way of setting up the 8200 is to use a test set (which is a PC) running TS8210 (supplied by Sutron) or almost any other communications program. By using it and a PC, users can view complete menus and data, making it faster to operate the 8200. Both of these methods will be discussed in the following paragraphs.

The front panel of the 8200 data recorder is shown on the opposite page. The main items identified on the front panel are:

- The display
- The 6-button keypad ▶ ◀ ▲ ▼ ON/OFF SET
- Terminal Strip (Removable)
- RAM Card Socket
- RS-232 Serial I/O port
- SDI-12 Auxiliary I/O port
- Ground Lug (Chassis)

Each item is described briefly in the paragraphs that follow.

The Display

The dark red opaque area at the upper left of the front panel is the system display. It is in this area that the 8200 displays a variety of messages which are used to set up and test the unit. The display can also give prompts and messages that are generated by the TINY-BASIC application program loaded into memory. The display is ON generally only after the ON/OFF key is pressed (see below). The brightness of the display can be adjusted by pressing the SET key immediately after the display has been turned ON.

The 6-button Keypad

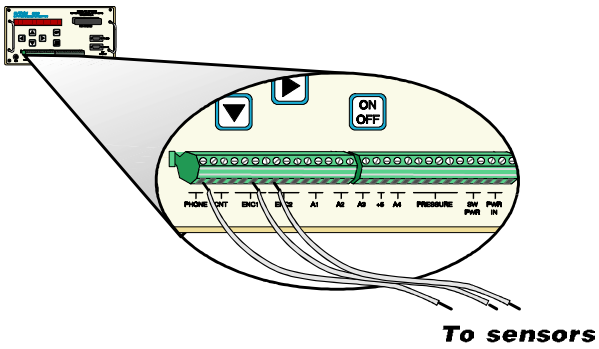
The 6-button keypad (▶ ◀ ▲ ▼ ON/OFF SET) is used to control the 8200. The ON/OFF key toggles the display on and off. The four blue outlined keys marked with black triangles control the position of the display window in the menu tree. They cause the display to move up, down, left, and right in the menu tree. The SET key is used along with the arrow keys to adjust settings in the display window.

Terminal Strip

Terminal strips are used to connect sensors, power, and some communication to the 8200. There are three basic configurations for terminal strips depending on the model ordered:

8210-0014-1 --The terminal strisp in the 8210-0014-1 are built in to the side of the fiberglass enclosure.
8210-0014-2 -- The terminal strips are on a separate, detached board that can be mounted anywhere in the enclosure.
8200A -- The terminal strips are located at the bottom of the front panel are used to connect instruments and/or an external power source to the 8200.

Connections to the terminal strip are made as follows:



- strip approximately 1/8th inch of insulation from the end of a signal or ground wire
- loosen the appropriate terminal block screw
- insert the stripped portion of the wire into the small, rectangular opening immediately beneath the screw
- re-tighten the screw.

After all connections are made to an 8200, the connectors may be unplugged from the unit with all wiring intact. To remove a connector, grasp each end firmly and pull/wiggle until it comes free. The removable connectors make it possible to completely replace an 8200 in a matter of minutes.

RAM Card Socket

8200s can store either data or setups on small RAM Cards which may be purchased from Sutron. The 8210 supports PCMCIA Statid RAM cards (not Flash) with a capacity up to 2MB. The 8200A supports RAM cards with a capacity up to 64K bytes. (The 8200A RAM cards are not PCMCIA.) Each 8200A RAM Card can hold up to 64k bytes of data (approximately 32,000 readings). To transfer data from the 8200's internal RAM to the RAM Card, or to transfer a pre-programmed set-up from a RAM Card to the 8200, the Card is inserted into the RAM Card socket. It is possible to store the data from multiple sites on a single card as space permits. Further instructions for loading or unloading data are contained on page 9-1 in Chapter 9.

RS-232 Serial I/O Port

The most common use of the RS-232 port is for connection to a test set (portable PC). When a test set is used, it is possible to see the full setup menus since the computer screen can display an entire menu at one time. This can simplify the setup process.

Experienced users who prefer setting up ahead of time may upload a preprogrammed setup into the 8200 from the test set thereby greatly reducing setup time. Conversely, the 8200 can also download setups and dump data from its memory to the test set through the same RS-232 port.

This multiple use serial port can also be configured for communication with:

- an external radio or telephone modem
- a Sutron 9000
- a printer
- RS232/RS485 sensors

SDI-12 Port

The SDI-12 Port provides support for a special serial-digital sensor standard devised by the U.S. Geological Survey. The SDI-12 standard allows multiple SDI devices to be connected to an 8200 with each device being able to report up to 9 different parameters. The 8210 has 2 sets of SDI-12 connections on the terminal strips for connecting multiple SDI-12 devices. The 8200A has a single DB9 connector for the SDI-12 connection. If you have more than one SDI device to connect to the 8200A, you may want to use some kind of external terminal strip instead of connecting all the sensors directly to the 9 pin connector.

Ground Lug

A ground lug is provided on each 8200 in order to connect the 8200 to an EARTH ground at the site. On the 8210-0014-1, this ground lug is on the side of the enclosure. On the 8210-0014-2, the ground lug is on the protection/termination board. On the 8200A, the lug is in the lower left front of the 8200A. Normally, you should run a 16 gauge wire from this lug to the site ground rod. Failure to do so can render the site more susceptible to damage by lightning.

Front Panel Control of the 8200

Now that you have a working knowledge of the components of the front panel display, it is time to learn about the 8200's inner workings. As mentioned earlier, the 8200 may be set up by means of the front panel buttons or a PC equipped with appropriate software. Even though the 8200 can be set up without using the front panel, it is important to know how to operate it in this way.

Turning the display unit on and off

The blue-outlined ON/OFF key on the front panel toggles the display on and off. If the display is turned on and left on with no input/output activity it will turn itself off after 60 seconds (the time-out period is settable). This time-out feature conserves battery power.

Changing the Display Brightness

The brightness of the display can be changed by pressing SET when the message Sutron 8210 xxvv is displayed. The best time to do this is immediately after turning the display ON. Each time SET is pressed, the brightness will change. There are three brightness levels to choose from.

The 8200 Menu Tree

The dark red front panel display area can be thought of as being a "window" into the menu tree. Moving this "window" up and down the menu tree allows the user to see, and control one level setting at a time. The entire menu tree contains all of the items available to set up and control the 8200. Not all the items are needed each time the 8200 is set up. In this chapter, we will teach you how to move around through the various menus using the arrow keys. You do not need to be concerned with the meaning of all

the items in the menu. The complete description of every menu item is explained in Chapter 4.

For your convenience, a menu tree for the standard 8200 is illustrated in full view on the next page. Use it as a reference guide both now and when setting up the 8200. Note that Menu trees for different model 8200's are similar to the standard version, only with a few changes appropriate to their different functions (these items appear in bold in the tree).

The 8200 Front Panel Menu Tree

- Sutron 8210 xxxx
  - UnitID
  - Date
  - Time
  - Recording
  - Alarm
  - VIEW DATA
    - LIVE READINGS
    - NEWEST READINGS
    - OLDEST READINGS
    - Alarm Status
  - SYSTEM SETUP
    - MEASUREMENT SCHEDULE
      - MeasInt
      - SampInt
      - MeasTim
      - SampTim
      - PwrTim
      - #Samples/Set
      - #Measmnt/Log
      - BasInt
      - BasTim
      - PwrMode
    - ENABLE SENSORS
      - Analog1
      - Analog2
      - ...
    - CONFIG SENSORS
      - Measure
      - Log
      - Average
      - Intrvl
      - Value
      - Slope
      - Offset
      - Elevation
      - Right Digits
    - ALARM OPTIONS
      - Enable
      - Groups **(GOES)**
      - Control
      - Trend **(MODEM)**
      - High Alarm
      - Low Alarm
      - ROC Alarm
      - HiLev
      - LoLev
      - ROCLev
      - Deadbnd
      - Prefix/Name **(MODEM)**
      - Suffix/Units **(MODEM)**
    - Change Password
    - Init Setup
    - Zero Counters
  - DUMP DATA
    - Start
    - Auto Dump
    - Ram Card
    - Serial Port
    - Read Card Setup
    - Write Card Setup
    - Erase Ram Card
  - EEROM SETUP
    - Serial
    - User Rate
    - Radio Rate
    - Com Rate
    - Dump Rate
    - SDI Rate
    - Enter Reqd
    - Log Dump
    - TimeLimit
    - PowerDelay
    - PressDelay
    - AnalgDelay
    - AutoKey
    - TimeFmt
    - DateFmt
    - BasicSize
  - PROTOCOL SETUP
    - Master
    - CarrierDly
    - ReplyDelay
    - Ack Delay
    - TN Rate
    - TA Rate
    - RetryIn
    - # Retries
    - Use RS-485
    - Long Packets
    - HW Handshake
  - MODEM SETUP **(MODEM)**
    - Dial-Out
    - AnswerMode
    - Number Rings
    - PhonePass
    - DialIn
    - DialOut
    - #1:
    - #2:
    - #3:
    - Redial
  - GOES Radio Setup **(GOES)**
    - Tx Mode
    - SatID
    - Internatl
    - Format ST
    - Carrier ST
    - Channel ST
    - Time ST
    - Rate ST
    - #Data/TX ST
    - DatTmST
    - DatInST
    - Channel RR
    - RN Rate
    - RA Rate
    - #TX/Alarm RR
    - AlmInRR
    - #Data/TX RR
    - DatTmRR
    - DatInRR
  - INSPECT SYSTEM
    - Perform Selftest
    - Display Status
    - Clear Status
    - Enter SDI-12 Cmd
    - Production Test
    - Select Radio
    - Test LOS Radio
    - Bert LOS Radio
    - Transmit Status
    - GOES RADIO TEST **(GOES)**
      - Send Selftimed
      - Send Random
      - Send to Sutron

Positioning within the menu tree

Positioning within the menu tree is controlled by the 4 keypad keys marked with black triangles. Pressing the ▼ (down arrow) key causes the display window to move one step down in the menu. Similarly the ▲ (up arrow) key causes the display window to move up within a menu. The ► (right arrow) key is used to "select" or "move into" a menu heading. For example, when the display window has been moved down the main menu until VIEW DATA is shown, pressing ► will shift the display to show LIVE READINGS (the first item of the VIEW DATA sub menu). If the menu item has no sub-menu, pressing ► will have no affect. The ◄ key moves you left or up one menu level each time it is pressed. If you are in a sub-menu, pressing ◄ will return you to the previous higher menu level. No matter where you are in the menu tree you can return to the top of the main menu by pressing ◄ no more than four times.

Practice moving through the menus using the arrow keys. From the "top" with the prompt "Sutron 8210 xxvv" press the ▼ key until the display shows VIEW DATA. Press ► and the display will show LIVE READINGS. Press ▼ until the display shows Alarm Status. Look at the menu tree to see the path you followed by pressing the keys.

Now press ◄ to return to VIEW DATA.

Press ▼ until INSPECT SYSTEM is displayed. Press ► and the display will show Perform Selftest.

Press ► again and notice that the display does not change. This is because there is no sub-menu for Perform Selftest. As a general rule, when the display is in all capital letters, you can press ► to bring up a sub-menu. When the display is in a mixture of upper and lower case letters, there is no sub-menu.

Press ◄ as many times as it takes to get back to the "top" of the menu tree.

> Special Tip: If you hold one of the arrows down for more than a half second, it will automatically repeat.

Now that you can navigate through the menus, let us introduce a few terms or conventions we have adopted to help describe the 8200 menus.

MAIN MENU -- We will use the term *main menu* to describe all those items that appear by pressing only the down arrow from the top of the tree. These items are UnitID, Date, Time, Recording, Alarm status, VIEW DATA, SYSTEM SETUP and so forth. (When using a PC, all these items appear in a single menu which makes the concept of a MAIN MENU more clear.

MENU, SUBMENU -- There are also other *menus* and *submenus* in the 8200. Like the *main menu*, they contain all the items that appear by pressing only the down arrow. The SYSTEM SETUP menu has the items MEASUREMENT SCHEDULE, ENABLE SENSORS, CONFIG SENSORS, ALARM OPTIONS, Change Password and SETUP. As a convention, any item that is in all capital letters is another menu.

FIELD -- We will use the term *field* to describe any item in the menus that accepts a value. You will always see the value displayed next to the name of

the *field*. *Time* is a *field* (which holds the value of the time) as is Recording and many others. You set the 8200 by changing the values of the *fields*. You will note that the *fields* have names with both upper case and lower case letters.

FUNCTION -- Some items in a menu look like *fields* but do not have a value displayed. These are *functions*, that cause the 8200 to do something. An example of a *function* is Init *Setup* that causes the 8200 to clear and initialize its setup to default values.

MENU PATH -- A final convention that we have developed is what we call the ***menu path***. The menu path is a concise way of explaining the menus and sub menus used to go to a specific *item*. You read the menu path from left to right and MAIN MENU is implied in the path. For example

MENU PATH=SYSTEM SETUP\MEASUREMENT SCHEDULE\Switched Power Options.

tells you to select SYSTEM SETUP from the MAIN MENU (main menu is implied) and then MEASUREMENT SCHEDULE (from the SYSTEM SETUP menu) and then Switched Power Options (from the MEASUREMENT SCHEDULE menu).

Changing Values and Executing Functions

Functions are executed and fields are changed by means of the SET key and the arrow keys. The following paragraphs illustrate how these keys are used to set the *Unit ID*, *Date*, *Time*, and *Recording*. Similar keystrokes are used to change any field in any menu tree.

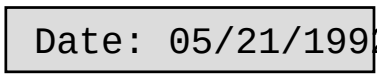
Setting the Unit ID

The *Unit ID* is the second entry in the main menu. To select the *Unit ID* press the ▼ key once after the Sutron 8210 vvxx message is displayed. To change the *Unit* ID*,* press the SET key. A flashing cursor will appear at the first character of the *Unit ID*. To change the first character, press the up or down arrow keys. Each depression will cause the displayed character to change. Numbers from 1 through 0 and letters from A through Z are available. When you have the desired selection displayed, press the ▶ right arrow key to move to the next character. Repeat this process until the *Unit ID* is correct. (You can move backwards in the *ID* by pressing the ◀ left arrow key.

When you have entered the *Unit ID* you desire, press SET to make it permanent. The flashing cursor will disappear and your selection will be saved. If you wish to cancel your change of the *Unit ID,* press ON OFF instead of SET. This causes the 8200 to ignore your selection, and restore the original value for the Unit ID.SET

Setting the Date

The *Date* is the third entry in the main menu. To select the *Date*, press the down arrow key once after setting the *Unit ID*, or twice after the Sutron 8210 xxvv message is displayed. The date will normally be displayed in the Month-Day-Year format such as:



To change the *Date*, press the SET key. When SET is pressed, a flashing cursor will appear on the first character of the month field. To change the first character of the month, use the up and down arrow keys, just as in setting the *Unit ID*. To change the second character, press the right arrow key and then use the up/down arrow keys to select the proper digit. Now, try to press the ▶ key again. Notice that the 8200 will not allow you to advance to the day value by using the arrow key. You must first save or "set" your new selection of the month before advancing to the day. To do so, press SET.

When SET is pressed, the cursor will shift to the first digit of the day field. Set the day in the same way as the month and press SET to shift to the year field. Set the digits in the year using the arrow keys. Press SET a final time to complete the operation of setting the Date.

Setting the Time

The *Time* is the fourth entry in the main menu. To select *Time*, press ▼ once after setting the *Date*, or three times after the Sutron 8210 xxvv message is displayed. To change *Time*, press the SET key. *Time* is displayed in the following 24-hour format:

```
Time: 17:55:01
```

The seconds field will be advancing steadily as the display is viewed. When SET is pressed, a flashing cursor will appear at the first digit of the hour field and the time will stop advancing. To change the first digit in the hour field, use the up and down arrow keys, just as in setting the *Unit ID* or date. To change the second digit, press ▶ and then use ▲/▼ to select the proper digit. When the hour is correct, press SET to "lock" that field and shift the cursor to the first digit of the minute field. The minute and second fields are then set in exactly the same way as the hour field.

Setting *Time* is an important operation. Many data collection activities depend on the accurate synchronization of times between numerous data collection devices.
The correct and most accurate method for setting the time in the 8200 is to select the *Time* display, and key in a full time (up to the seconds value) that is one or two minutes in advance of the current time. Since the 8200 senses that an operation is being performed, it will not automatically shut off the display while you are waiting for the time synchronization. Press SET only when the time on the display coincides exactly with the time on an accurate source (Digital wrist watch, radio time signal, etc.). From that point on, the display should be in synchronization with reference time. This can be verified by watching the display for a short period.

Options With Pre-Defined Values

Up to this point, you have learned how to program in values for menu items (fields) that require user specific data such as the time and date. In addition to these types of settings are fields which contain a limited number of pre-defined, unalterable values. In this type of menu field, the value of the field changes to the next legal value each time SET is pressed.

For example, with the Display at Recording: OFF, pressing SET will cause the 8200 to change the value to ON. (Some error or status messages may be displayed if the 8200 is not ready to start recording). Similarly, with Recording: ON, pressing SET will cause the 8200 to change it to OFF.

At times there are more options than just ON and OFF. For example, the *Serial* field in the EEROM SETUP menu has the value options: USER, SENSOR, LOGGER, PROTOCOL, RADIO, EXTMODEM, MODEM. (values in all CAPS do not contain sub-menus). Each time SET is pressed, the display scrolls to the next possible value for the field, eventually moving back to the beginning of the list. For the EEROM SETUP field of User Rate, pressing SET will cause the display to cycle through all the available baud rate values for the serial port 110, 300, 600, 1200, 2400, 4800, 9600 and so forth. To lock in a value, simply press the left arrow button to exit the option.

When working with fields with pre-defined values, the 8200 remembers only the value that was displayed when you exited the field. So, if you press SET and change the EEROM SETUP, Serial: option from USER to PROTOCOL and then press ◄ (or let the display time-out), the next time you view Serial: it will be set to PROTOCOL.

PC Control of the 8200

Those users wishing to take advantage of the 8200's powerful interfacing capabilities may choose to set up their unit with a PC instead of with the front control panel. Although using a PC to set up the 8200 requires a different method of value setting, the process is much simpler and less time consuming. The first step is to hook up the 8200 and the computer together and get the communications software up and running.

Starting the PC Software

Any PC can be used as a test set as long as it has a serial port and a communications program such as the Sutron designed TS8210.

> Note: if using a commercial communications program, set it for 9600 baud, 8 bits, no parity, 1 stop bit.

To link the two machines together, connect a standard 9 pin straight cable from the COM1 port to the 8200 Serial RS-232 port. Should you need to make a cable yourself, refer to the information on page 7-13.

Start the TS8210 program by typing TS8210 at the C:\ prompt of your computer or whatever subdirectory the TS8210 program happens to be in. The 8200 should display the main menu onto the PC screen. If you do not see the main menu when TS8210 is started, or if the display blanks, press the F10 key. This sends a signal to the 8200 to wake up and display the menu again.

If the 8200 still does not display the main menu, you must use the front panel of the 8200 to verify that the EEROM setup is configured for the Serial port. To do so, press ON/OFF to turn on the display and then use ▼ until EEROM SETUP is displayed. Press ► and the display should show Serial: USER. If it does not, press SET repeatedly until the USER value appears. Then use ▼ to display the User rate (Baud operating speed). It should show the baud rate as 9600 baud. If it does not, press SET until the baud rate is 9600. Press F10 on the PC to try again. If you are still having difficulties, consult the Troubleshooting chapter (10) for help.

The 8200 Menu Tree

Since the PC screen is obviously much larger than the small 8200 display, it is able to give a full view of the menus. A complete list of the 8200 PC menus is shown on the following pages. Note that PC menus are able to show all the items of a menu grouped together. Separate menus are given for each of the model 8200s; however, all 8200s share most of the same menus and fields.

If you will remember, when using the front panel display to set up the 8200 you were required to push the directional arrows to move around the menu tree. When using a PC, the letter in front of each option indicates the key that must be pressed in order to select the item and move around the menu. For example, pressing V will bring up the VIEW DATA menu. Pressing A from within this submenu will bring up the Alarm Status display. The [ESC] key on the PC is used to return to the previous menu.

Practice using the menus by selecting some of the keys such as E to select EEROM Setup, or S for System Setup. Press [ESC] to return to the main menu. Note that when you press R from the main menu, a submenu does not appear. Instead, the 8200 will change or scroll through the state of Recording options; ON and OFF. This is an example of a field that you can set; it is not a menu that can be displayed.

PC Menus

MAIN MENU
- N - Unit Name
- D - Set Date
- T - Set Time
- R - Recording Status
- C - Clear Alarm
- V - View Sensor Data
- S - System Setup Options
- U - Upload/Download Data
- E - EEROM Setup Options
- P - Protocol Setup Options
- **M - Modem Setup Options**
- **G - GOES Radio Setup**
- I - Inspect System
- A - Application Menu
- X - Exit

Choose:

Upload/Download Data Menu
- D - Start Date
- P - Protocol
- A - Auto Dump
- C - Send to Ram Card
- S - Send to Serial Port or Modem
- R - Read Setup from Ram Carrd
- W - Write Setup to Ram Carrd
- T - Transfer Setup
- B - Transfer Basic Program
- Y - Ymodem Ram Card File(s)
- I - Transfer Raw Ram Card Image
- V - View Ram Card Directory
- E - Erase Ram Card

Choose:

GOES Radio Random Setup Menu
- **1 - Channel (RR)**
- **2 - TX Normal Rate (RR)**
- **3 - TX Alarm Rate (RR)**
- **4 - # TX/Alarm (RR)**
- **5 - Alarm Interval (RR)**
- **6 - # Data Items/TX (RR)**
- **7 - Data Time (RR)**
- **8 - Data Interval (RR)**

Choose:

View Sensor Data Menu
- L - Live Data
- N - Newest Data
- O - Oldest Data
- A - Alarm Status

Choose:

EEROM Setup Menu
- M - Serial Port Mode
- U - User Baud Rate
- R - Radio (LOS) Baud Rate
- C - Com Baud Rate
- T - Transfer Baud Rate
- S - SDI-12 Baud Rate
- E - Enter Key Required
- D - Log Dump Mode
- L - User Time Limit (sec)
- O - Power On Delay (10*ms)
- P - Pressure Delay (10*ms)
- A - Analog Delay (10*ms)
- K - Auto Startup Keys
- 1 - Time Format
- 2 - Date Format
- B - Basic Prog Size (KB)

Choose:

Alarm Options
- E - Enable
- **G - Groups**
- C - Control
- 1 - High Alarm
- 2 - Low Alarm
- 3 - ROC Alarm

Alarm Limits
- H - High Limit
- L - Low Limit
- R - ROC Level
- B - Deadband

Alarm Phrases
- **P - Prefix (Name)**
- **S - Suffix (Units)**

System Setup Menu
- M - Measurement Schedules
- E - Enable Sensors
- C - Configure Sensors
- A - Alarm Options
- B - Basic Program
- P - Change Password
- I - Init Setup
- Z - Zero Counters

Choose:

Protocol Setup Menu
- M - Master Name
- C - Carrier Delay (.1s)
- R - Reply Delay (.1s)
- A - Ack Delay (.1s)
- 1 - TX Normal Rate
- 2 - TX Alarm Rate
- 3 - Retry Interval
- N - Number of Retries
- U - Use RS-485 w/SDI-12
- L - Long SSP Packets
- H - H/W Handshake on COM

Choose:

Modem Setup Menu
- **D - Dial-Out Enable**
- **A - Answer Mode**
- **N - Number of Rings**
- **P - Phone Password**
- **I - Dial-In Message**
- **O - Dial-Out Message**
- **1 - Phone #1**
- **2 - Phone #2**
- **3 - Phone #3**
- **R - Redial Delay**

Choose:

Measurement Schedules
- M - Measurement Interval
- I - Sampling Interval
- T - Measurement Time
- S - Sampling Time
- P - Switched Power Time
- A - Samples to Average
- L - Measurements per Log
- B - Basic Run Interval
- R - Basic Run Time
- O - Switched Power Options

Choose:

Inspect System and Test
- S - Perform Selftest
- D - Display Status
- C - Clear Status
- E - Enter SDI-12 Commands
- T - Talk to Modem or Terminal
- **G - GOES Radio Test**
- M - Monitor SSP Communications
- P - Production Test

Choose:

FRONTPANEL ONLY:
- Test LOS Radio
- Transmit Status

Configuration
- M - Measure
- L - Log
- A - Average
- I - Interval

Calibration
- V - Value
- S - Slope
- O - Offset
- E - Elevation
- R - RightDigits

GOES Radio Setup Menu
- **T - Transmit Mode**
- **S - Satellite ID**
- **I - International**
- **F - Format (ST)**
- **C - Carrier (ST)**
- **1 - Channel (ST)**
- **2 - TX Time (ST)**
- **3 - TX Rate (ST)**
- **4 - # Data Items/TX (ST)**
- **5 - Data Time (ST)**
- **6 - Data Interval (ST)**
- **R - Random Setup Menu**

Choose:

Selecting options and changing values

To change the value for a field, press the key identified for the field. If the field has predefined options, the value will change to one of the predefined values. If the field has a user entered value, the cursor will move to the place where the value is displayed and let you key in the value. The following paragraphs illustrate how the keys are used to set the *Unit ID*, *Date*, and *Time*. Similar keystrokes are used to change any programmable item in any menu tree.

Setting the Unit Name (UnitID)

The *Unit Name (UnitID)* is the second entry in the main menu. The letter N is used to select this item to change it. Press N and the cursor will jump to the Unit Name that is displayed. Type in a new unit ID or press [BACKSPACE] and edit the existing ID. When the value is correct, press [ENTER]. You may press [ESC] at any time to cancel the change to the Unit Name.

Setting the Date

The Date is the third entry in the main menu. To select the Date, press "D" and the cursor will jump to the first field in the date. The date will normally be displayed in MM/DD/YY format such as:

05/21/1992

Type in a new month or press [BACKSPACE] and edit the existing month. Once you are satisfied with the change, press [ENTER] to "lock" in the new monthly value and go to the next field which is the day. Use the same steps to change the day and year. Pressing [ENTER] while in the year field will cause the 8200 to accept the entire new date. If [ESC] is pressed at any time, the cursor returns to the menu without changing the date.

Setting the Time

The Time is the fourth entry in the main menu. To select the Time, press "T" and the cursor will jump to the hours field. Type in a value for the hours or press [BACKSPACE] and edit the existing hours value. Press [ENTER] to go to the minutes section. Use the same steps to change the minutes and seconds.

Setting the time is an important operation. Many data collection activities depend on the accurate synchronization of times between numerous data collection devices.

The correct and most accurate method for setting the time in the 8200 is to select the Time display, and key in a full time (up to the seconds value) that is one or two minutes in advance of the current time. After keying in the correct value for the last field (seconds) wait to press [ENTER] only when the time on the display coincides exactly with the time on an accurate source (Digital wrist watch, radio time signal, etc.).From that point on the display should be in synchronization with the reference time. This can be verified by watching the display for a few seconds.

Changing Pre-Defined Values

If an item has a pre-set value, the 8200 will change the value each time the item is selected. For example, go to the main menu and press "R". If the current status is Recording: OFF, the 8200 will try to set it to next available option of ON and vice versa.

Go to the EEROM Setup Options menu and note the value for Dump Rate (also known as the Transfer Baud rate). Press "T" several times and watch the display cycle though the available values for the baud rate. Note that each time you press "T" you are scrolling to the next available value for the item. The only way to set it back to its original value is to repeatedly press "T" until the original value is displayed again.

The Setup Sheet

Now that you know how to navigate the menus of the 8200 and enter values, you are ready to learn about the actual method behind an 8200 setup. Perhaps the best way to familiarize yourself with this step is by using the setup sheet included on the next page. The setup sheet has been prepared for you as a way of specifying the intended setup for an 8200.

The setup sheet closely matches the 8200 menus, making it simple to use the sheet as a reference when entering a setup. The sheet provides spaces for the values that may be entered into various fields in the 8200 to configure it for proper operation.

The setup information is divided into two different setup sheets. The first sheet -- Sensor Setup -- contains the configuration data and alarm data for all enabled sensors. Each column in this sheet contains the setup information for a single sensor. Since there are only six columns on this sheet, you will need to use additional copies of the sheet if there are more than six sensors in your setup.

The second sheet defines the values for the Measurement Schedules, EEROM settings, and optional GOES and MODEM setup information. Note that EEROM SETUP and PROTOCOL SETUP have two columns -- one listing default values and the other a blank for your selection.

As an example, the setup sheet has been filled out for a simple site measuring precipitation and battery. This setup measures data from the precipitation sensor and battery every minute and stores the data in the log.

To program the setup into the 8200, simply enter the information from the sheet into the 8200:

- Go to SYSTEM SETUP\MEASUREMENT SCHEDULE and enter the information from page 2 under the same heading
- Go to SYSTEM SETUP\ENABLE and enable the appropriate sensors as given on the setup sheet. Also change the name for sensors as required.
- Go to SYSTEM SETUP\CONFIGURE and enter values into the fields for the sensor as given on the setup sheet. Finish one sensor before going on to the next one.
- Repeat the above steps for the ALARM SETUP.
- Check and enter the values from the rest of page 2 of the setup sheet. The information can be easily entered into the 8200 by noting:

The sheets have the values grouped so that it is simple to read the data off the sheet and enter it into the 8200.

8200 SENSOR SETUP

UnitID _____

Location _____

Name _____

SYSTEM SETUP\ENABLE SENSORS

8200 Sensor Type		Counter	Battery				
Enable	ON/OFF	ON	ON				
New Name (optional)							

SYSTEM SETUP\CONFIG SENSORS

Measure	ON/OFF	ON	ON				
Log	ON/OFF	ON	ON				
Average	ON/OFF	OFF	OFF				
Intrval	00:00:00						
Value (Forced)	0000.000						
Slope	0000.000	0.01	1.0				
Offset	0000.000	0.0	0.0				
Elevation	0000.000						
RightDigits	0-3	2	1				

SYSTEM SETUP\ALARM OPTIONS

Enable						
Groups (GOES ONLY)						
Control						
Trend (MODEM ONLY)						
High Alarm						
Low Alarm						
ROC Alarm						
HiLev						
LoLev						
ROCLev						
DeadBnd						
Prefix (MODEM ONLY)						
Suffix (MODEM ONLY)						

General Setup

SYSTEM SETUP\Measurement Schedule

MeasInt	00:15:00
SampInt	
MeasTim	
SampTim	
PwrTim	
#Samples/Set	
#Measmnt/Log	
BasInt	
BasTim	
PwrMode	

EEROM SETUP

Serial		USER
User Rate		9600
Radio Rate		1200
Com Rate		1200
Dump Rate		9600
SDI Rate		1200
Enter Reqd		OFF
Log Dump		ALLBIN
TimeLimit		60
PowerDelay		1
PressDelay		5
AnalgDelay		5
AutoKey		(blank)
TimeFmt		NORMAL
DateFmt		MDY
BasicSize		1

PROTOCOL SETUP

Master		(blank)
CarrierDly		7
ReplyDelay		0
ACK Delay		100
TN Rate		00:00:00
TA Rate		00:10:00
RetryIn		00:01:00
# Retries		3
Use RS-485		OFF
Long Packets		ON
HW Handshake		OFF

GOES Radio Setup

Tx Mode	
SatID	
Internatl	
Format ST	
Carrier ST	
Channel ST	
Time ST	
Rate ST	
#Data/TX ST	
DatTmST	
DatInST	

Random Setup Menu

Channel RR	
RN Rate	
RA Rate	
#TX/Alarm RR	
AlmInRR	
#Data/TX RR	
DatTmRR	
DatInRR	

MODEM Setup

Dial-Out	
AnswerMode	
Number Rings	
PhonePass	
DialIn	
DialOut	
#1:	
#2:	
#3:	
Redial	

Exercise

Now, enter the information from the sample sheet into the 8200. The main steps you should follow to set up the 8200 are:

- Enter Measurement Schedule
- Enable Sensors
- Configure Sensors.

You may use either the front panel or test set. Try it yourself. If you need help refer to the guide that follows.

Steps using Front Panel

Step 1, Moving to SYSTEM SETUP (Menu Path=SYSTEM SETUP)

If you have not already done so, turn on the 8200 display by pressing ON/OFF. Sutron 8210 xxvv should be displayed. If the unit is already on and something other than Sutron 8210 xxvv is displayed, press ▲ until the message is displayed. This is the top of the menu tree.

To move to the SYSTEM SETUP item in the main menu, use ▼. Use ▲ if you go too far.

Step 2, Setting the measurement schedule (Menu Path=SYSTEM SETUP\MEASUREMENT SCHEDULE)

With SYSTEM SETUP in the display window, press ► to move to the MEASMNT SCHEDULE sub-menu. Press ► again to move into the MEASMNT SCHEDULE sub-menu. The display window will show MeasInt xx:xx:xx. Press the SET key and use the procedures described under setting the Time and Date to select the desired interval between measurements. For this example, set the MeasInt to 00:01:00 -one minute. The fields in MeasInt are hours, minutes, and seconds.

MeasInt is the only setting required in the MEASUREMENT SCHEDULE for this simple application. After setting the *MeasInt* you may use ▲ and ▼ to see some of the other times which should all be set to 00:00:00.

Step 3, Enabling sensors (Menu Path=SYSTEM SETUP\ENABLE SENSORS)

Press ◄ to return you to display MEASMNT SCHEDULE. Press ▼ to move to the ENABLE SENSORS sub-menu. Press ► to move into the sub-menu. The display will read Analog1 xx, where xx is ON or OFF.

The ENABLE SENSORS sub-menu contains a Master Sensor List of all the ways the 8200 inputs can be configured. Press ▼ until Counter is displayed. Press SET to toggle the Counter ON. Continue pressing ▼ until Battery is displayed. Toggle it ON also.

Step 4, Configuring sensor inputs (Menu Path=SYSTEM SETUP\CONFIG SENSORS)

Pressing ◄ to return to the main menu. The display will be at the ENABLE SENSORS item. Press ▼ to move to the CONFIG SENSORS sub-menu. Press ► to move into the sub-menu. The display should show Counter _____. If it shows another sensor, press ▼ until COUNTER is displayed.

Press ▶ to enter the configuration submenu for the COUNTER. The display will show MEASURE xx, where xx is ON or OFF. Press SET to toggle MEASURE ON.

Press ▼ to move down the COUNTER submenu. The display will show Log xx, where xx is ON or OFF. Press SET to toggle logging (recording in memory) ON. If Log is OFF you will get no recorded data for a sensor, regardless of other settings.

Press ◀ and the display will return to the sensor list and will show COUNTER MeLg. The Me indicates that Measure is On and Lg indicates that LOG is ON.

Press ▼ to select the BATTERY submenu. The display will show BATTERY. Press ▶ to enter the submenu and use the same steps as described for the COUNTER to turn on Measurement and Logging for the BATTERY. Press ◀ (missing text -- AG 3/16/93) should now show BATTERY MeLg__.

Steps using the Test Set

Step 1, Moving to SYSTEM SETUP (Menu Path=SYSTEM SETUP)

From the main menu, press "S" to select SYSTEM SETUP (You may also need to press [ENTER] to get the 8200 to accept your menu selection.)

Step 2, Setting the measurement schedule (Menu Path=SYSTEM SETUP\measurement schedule)

With SYSTEM SETUP Menu displayed, press "M" to select the Measurement Schedule. Press "M" to select the Measurement Interval and then press 0 [ENTER] 1 [ENTER] 0 [ENTER] to set the value 00:01:00 into the Interval.

There are no other values to change in the Measurement Schedule. Press [ESC] to return to the System Setup Menu.

Step 3, Enabling Sensors (Menu Path=SYSTEM SETUP\ENABLE SENSORS)

Press "E" to select ENABLE SENSORS. The display will show a complete list of all the sensors supported by the 8200. Note the cursor pointing to Analog1. Use the keyboard arrow keys to move the cursor to point to Counter. Press [ENTER] and note the "*" indicating that Counter has been enabled.

Use the keyboard arrow keys to move the cursor to Battery and again press [ENTER]. To disable a sensor, move the cursor to the name with a "*" in front of it and press [ENTER]. The sensor will be disabled and the "*" removed.

Press [ESC] to return to the System Setup Menu.

Step 4, Configuring sensor inputs (Menu Path=SYSTEM SETUP\CONFIG SENSORS)

Press "C" to select Configure Sensors. The display will show a list of enabled sensors on the left with a cursor pointing to the top value. The data on the right will be from the sensor the cursor is pointing to. If the cursor is not at Counter use the arrow keys to move it.

Press "M" to toggle Measure ON/OFF. If it shows OFF, press it again until it is ON.

Press "L" to toggle LOG ON/OFF. If it shows OFF press it again until it is ON.

Make sure the other values for COUNTER are correct and change them if necessary.

When you are finished configuring Counter, press the arrow key to move the cursor to BATTERY. Note that the values on the right will change as BATTERY is selected.

Following the same procedure as above, set Measure ON and Log ON and make sure all other values are correct.

Press [ESC] to return to the setup menu. Press [ESC] again to return to the main menu.

Operating the 8200

Turning on Recording (Menu Path=Recording)

With the 8200 set up, you are ready to turn on *Recording*. With *Recording* OFF, the 8200 will not automatically measure data or transmit it.

To turn ON *Recording* from the front panel, use the arrows to select *Recording* and press SET. The status of *Recording* should change to ON.

> Note: the 8200 will prompt *OK to erase log?* if you have made any changes to the setup that affect the log size (such as enable/disable logging of sensors or change *MeasInt*. If you see this message, press SET to proceed. Pressing any other key aborts the change to *Recording* ON.

To turn ON *Recording* from a test set, press "R" in the main menu. Again, note the change of the status to ON. If you see the OK to erase log, you will need to press Y to proceed. Pressing any other key aborts the change to *Recording* ON.

Viewing Live Data (Menu Path=VIEW DATA\LIVE READINGS..)

To view data from the front panel, press ▼ to display VIEW DATA followed by ►. The display will show LIVE READINGS. Press ► again to select the live readings and the live data for COUNTER will be displayed. If some sensor other than COUNTER is displayed press the ▼ down arrow until COUNTER is displayed. Press ▼ to view the BATTERY voltage. Use ▲ and ▼ to display the desired values. To exit the display, press ◄.

To view data from the test set, press "V" to select View Data followed by "L" for live readings. Then select sensors from the list by moving the cursor to the desired sensors and pressing [ENTER]. Selected sensors will show the "*". Note the menu at the top of the screen describes the keys the 8200 recognizes while in this menu. Press "V" to activate the viewing of data. Press [ENTER] to select the default update interval of 1 second. To exit the display, press [ESC].

To watch the live display of the COUNTER change, connect one wire to CNT-G and the other to CNT-1 and touch the ends of the two wires together. The value for counter will go up each time the wires are touched together. Note that the value may jump up by increments greater than one. This is because the "debounce" circuitry is designed for magnetic reed switches or mercury switches. Brushing wires together creates a very noisy signal which the circuitry cannot handle properly.

Viewing Logged Data (Menu Path=VIEW DATA\NEWEST READINGS..)

The NEWEST READINGS and OLDEST READINGS Sub-menus of VIEW SENSOR DATA are used to view logged data. Selecting either of these will let you view data in the log. As implied in the selection, NEWEST READINGS will start the display with the most recent data in the log and OLDEST READINGS will start with the oldest data in the log.

To view data using the front panel, first use ▼ to display VIEW DATA from the menu. Press ► to display LIVE READINGS and press ▼ to display NEWEST READINGS. Press ► to display COUNTER and ► again to see the most recent data. The display format will appear as:

135 1258 +00024

The left number in the display (135 in the example) is the Julian Calendar day. Press ► to see the full date. (It will only be displayed briefly.) The second value in the display is the time, and the third value is the recorded data. To move back in time, press ▲. To move forward in time, press ▼. To move back to the sensor list for NEWEST READINGS, press ◄. You may use ▲ and ▼ to select any other sensor that is logged followed by ► to view its data.

To view data using the test set, press "V" to display the View Sensor Data menu followed by "N" for the newest readings. A display of the most recent log entries will be displayed along with a menu across the top of the screen. If all the sensors do not fit on the screen, you will need to use the "R" and "L" keys or the arrow keys to scroll to the right and left. You may also scroll up and down using the U and D keys or the arrow keys.

Setups

The 8200 setup is in RAM, a type of memory that can be changed. This makes it possible for the 8200 to be configured by the customer to function a particular way. The setup can be quite short or long depending on its complexity. For improved reliability, the 8200 keeps a copy of the setup in a special area of write-protected and checked memory called EEROM.

When you make changes to the setup using the SYSTEM SETUP menu, the changes are automatically saved to EEROM when you leave the menu. The software only saves values for sensors that are enabled. Alarm information will also be saved only for sensors that are alarm enabled. The 8200 has room to store up to 70 sensors and their related alarm information in the EEROM. When the 8200 is powered on or reset, the setup in EEROM is automatically restored to RAM and used by the 8200.

The SYSTEM SETUP\Init Setup option can be used to clear out a setup from RAM. The cleared setup will also be copied to EEROM when you exit the SYSTEM SETUP menu.

> Note: previous versions of the 8200 software had separate functions to save and restore the setup. This caused confusion and inconsistencencies in the setup. This automatic saving and restoring will make the 8200 easier to use.

Other setup options found in the EEROM SETUP, PROTOCOL SETUP, GOES SETUP and others saved directly to EEROM as soon as they are changed.

The 8200 also has the capability to transfer the setup to and from a RAM Card that can be inserted into the front panel, and to and from a test set using the Xmodem or Ymodem protocols. Refer to Page 9-2 for details.

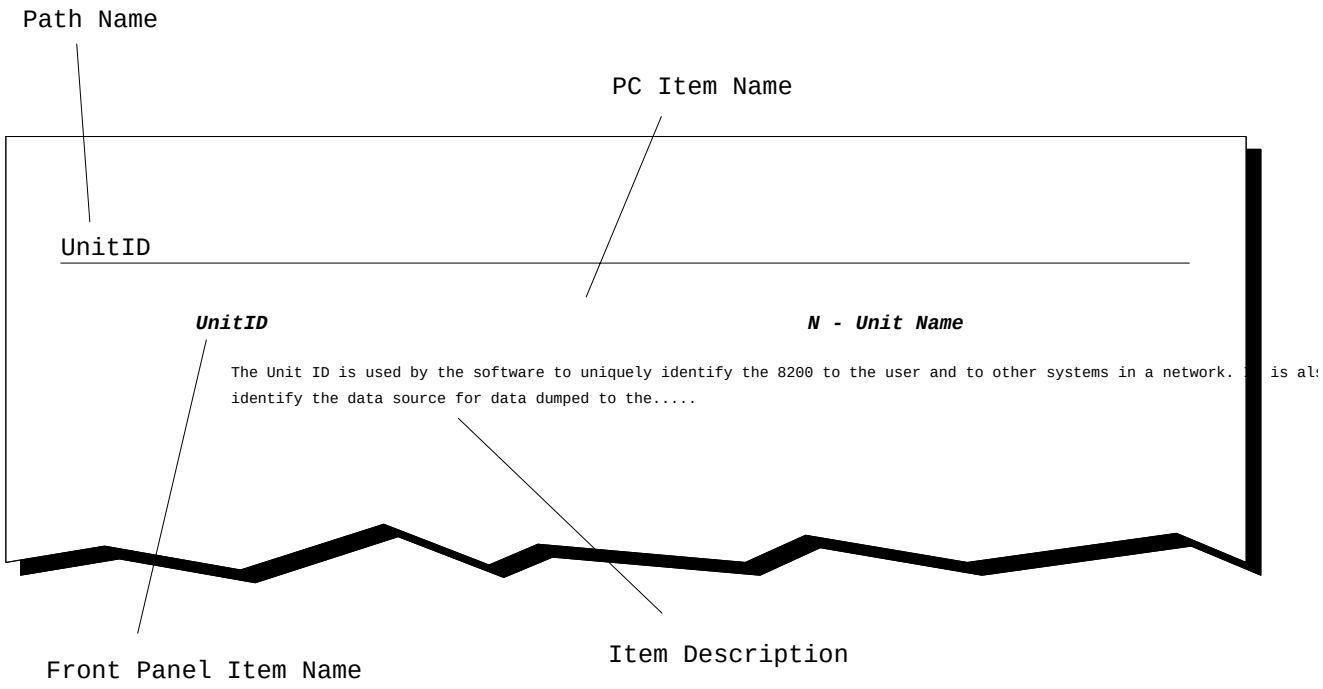
Chapter 4

Menu Tree Reference

This chapter describes in detail all the items that make up the 8200 setup. The chapter is not meant to be read from front to back but is intended as a reference.

8200 Menu Reference

Each Menu item in the 8200 is documented in the following sections. First, all the items of the Main Menu are documented, followed by each of the sub menus in alphabetical order. The items within each menu/sub-menu are listed in alphabetical order based on the front panel name. Each Menu item is described in a separate section identified by its Front Panel name, PC Menu Name, and Menu Path. For example, the entry for UnitID will appear as follows:



At the top of each page is a header that contains the menu path for one of the items described on the page. You can look at this header while turning pages to help you find a particular menu and item.

> The items in a sub-menu are described in alphabetical order based on the front panel name. If you are looking for an item based on its PC item name, you may need to search through all the items in a sub-menu to find the PC item name.

The menu path shows all the menus you must use to select a particular item. The Main Menu is implied in the menu path. The names in the menu path correspond to those seen on the front panel. If the PC names were used in the menu path, it would be similar but not identical. The following are some simple examples menu paths:

Date	This item is in the main menu.
SYSTEM SETUP\MEASMNT SCHEDULE\SampInt	This item (SampInt) is in the MEASMNT SCHEDULE submenu which is in the SYSTEM SETUP menu which is in the main menu.

Alarm

Alarm *C - Clear Alarm*

Alarm Status is part of the MAIN MENU display when using a terminal. The possible values for *Alarm* status are:

NORMAL	No alarm conditions exist, or all alarm conditions have been acknowledged.
ALARM!	An alarm condition exists and has not been acknowledged for a sensor that will not cause the 8200 to dial out.
ALERT!	An alarm condition exists and has not been acknowledged for a sensor that will cause the 8200 to dial out or transmit.

To clear an alarm from the front panel, press the SET key. Press "C" to clear an alarm when using a terminal.

Application Menu (PC only)

-- *A-Application*

This selection only works if you are running Sutron's test set software that has special applications support. TS9000 supports applications and allows dumping the log using SSP in TS9000 format. TS8210 at the current time does not support applications. Base Station software can also take advantage of this option to start a SSP session.

Date

Date *D - Set Date*

The *Date* and *Time* settings are used as references for making measurements and logging data. The system has an internal clock chip which maintains the date and Time. A jumper automatically controls whether or not a small internal battery will power the clock chip if and when main power is removed.

Since the date is used as a reference for the data written to the log, the system adjusts the log whenever the date changes. Normally, this happens automatically whenever the day changes. However, if you change the date, the system will detect the day change the next Time data is written to the log and will adjust it accordingly. If the change is small, the adjustment is rapid. Only that data which falls within the size of the log will be retained. For example, if you adjust the date one month forward (from 3/30 to 4/30) and the log had data for 1/1 to 3/30, you will still have the data for the Time period 2/1 to 3/30 with a blank area from 3/31 to 4/30. The 1/1 to 1/31 data would have been discarded. If you adjust the date outside the size of the current log, all data will be discarded.

If you adjust the date by several years, the system will take more time to make the adjustment and will 'lock' you out of the log until the adjustment has been made. See chapter 3 for examples in setting the date.

DUMP DATA

DUMP DATA ***U - Upload/Download Data***

DUMP DATA contains a sub-menu with a selection of commands that can be used to initiate the uploading or downloading of data to, or from a RAM Card or other device. When using a test set, the menu will also contain functions for transferring the setup and basic program between the test set and the 8200

(See separate headings under DUMP DATA for complete information)

EEROM SETUP

EEROM SETUP ***E - EEROM Setup Options***

EEROM SETUP is a menu item. These items affect some EEROM values that control the way the 8200 communicates and also contains some calibration and timing values. Once these values are set they are already in EEROM and do not need to be saved using *SaveSetup*.

(See separate headings under EEROM SETUP for complete information).

Exit (PC only)

-- ***X - Exit***

This selection logs you out of the 8200. If you are connected through a modem, the 8200 will also hang-up the phone.

GOES SETUP (GOES Models Only)

GOES SETUP (GOES Models Only) ***G - GOES Radio Setup***

Basic setup for self-timed reporting is controlled through the *GOES Radio Setup* sub-menu.
Eleven fields must be defined in order to make self-timed transmissions. The fields are:

TX Mode	Transmission mode, self-timed, random-reporting, or both
Format ST	Data message format
Internatl	Enable selection of international channels for 8200s used outside of the USA
Carrier ST	Message carrier length, short or long
SatID	Assigned ID code for this station (from NOAA-NESDIS)
Channel ST	Assigned self-timed channel
Time ST	Assigned self-timed reporting time
Rate ST	Assigned self-timed reporting interval
#Data/TX ST	No. of data items for each parameter taken from 8200 log and encoded in each self-timed transmission
DatTmST	Synchronization time - the time at which to begin extracting data from the log in order to build a message
DatInST	Data interval - the time interval between readings from the 8200 log (equal to or a multiple of MeasInt)

(See separate headings under GOES SETUP for complete information)

INSPECT SYSTEM

INSPECT SYSTEM I - Inspect System and Test

A special *Inspect System* sub-menu is provided which allows the user to quickly examine how the 8200 is setup and whether or not the unit is operating properly. Before leaving a field site, you may find this sub-menu to be useful in ensuring that a unit is properly programmed.

(See separate headings under INSPECT SYSTEM for complete information).

MODEM SETUP (Speech/Modem Models Only)

MODEM SETUP M - Modem Setup Menu

The *MODEM SETUP* Menu contains the settings needed to fully configure a modem equipped 8200 for data transmission.

(See separate headings under MODEM SETUP for complete information)

PROTOCOL SETUP

PROTOCOL SETUP P - Protocol Setup Options

The *Protocol Setup* defines important information used when the system communicates using its internal or external radios. These communications use Sutron Standard Protocol

(SSP), hence the name of the menu. One field in this setup, *Ack Delay*, also is used by the modem software when it communicates in SSP.

(See separate headings under PROTOCOL SETUP for complete information)

Recording

Recording *R - Recording Status*

Recording Status can be ON or OFF. When OFF, the 8200 will not perform any of its scheduled functions or run the BASIC program. Automatic Satellite transmissions, LOS radio alarm transmissions, and telephone alarm transmissions are disabled when recording is OFF. It will still be able to communicate with other systems (such as a 9000), however, the data it sends will not be updated to reflect current measurements.

When the *Recording Status* is changed to ON (ON&TX for GOES), the 8200 may resize the LOG if any sensors have been added which use the log. This may cause all the data in the LOG to be erased. A message will be displayed before erasing the log asking approval before it is erased. This gives you a chance to abort the change to Recording ON so you can save the data in the log (See page 4-69 for more on the LOG).

With *Recording* set to ON, the 8200 will use the schedule information to measure sensors, log data, run the basic program, and make transmissions.

If you leave a site without setting *Recording* ON, the site will not collect new data. For this reason, it is vital that you set *Recording* to ON as soon as the system has been setup. As an added precaution, you should also go to the SYSTEM SETUP sub-menu, SETUP selection and save the current setup with *Recording* ON. This makes it possible for the system to automatically turn *Recording* ON at power up.

As a safety measure, if recording is OFF and you turn the display OFF, the system will flash you the warning message "Recording is Off" to remind you that you are leaving the 8200 in a non-operational mode.

Satellite radio equipped units will also show the status ON&FT or OFF&FT if the failsafe of the transmitter has been tripped. Pressing SET will normally clear the failsafe condition (OFF&FT -> OFF), and pushing SET again will begin recording (OFF -> ON&TX).

When *Recording* is toggled ON, the 8200 checks for errors in the part of the setup that works with the recording. If the 8200 finds an error, a message is displayed and the *Recording* is left OFF. Possible error messages are:

Error Message	Corrective Action
Bad MeasInt	Measurement Interval too Short (must be greater than 0)
Bad #Measmnt/Log	#Measurements/Log too Small (must be greater than 0)
Too Much Data	Storage Space Exceeded, The log must be big enough to contain one full days worth of data at the current recording rate.

No Log RAM Log RAM not installed (or failed)

SYSTEM SETUP

SYSTEM SETUP S - System Setup

The *System Setup* menu provides a way to perform most of the essential functions needed to set up an 8200. The items in the menu provide a means to set up the following submenus:

Measurement Schedules
Enable Sensors
Configure Sensors
ALARM OPTIONS
Basic Program
Change Password
Init Setup
Zero Counters

(See separate headings starting with SYSTEM SETUP for complete information)

Time

Time T - Set Time

Time represents the current 8200 clock time. All 8200 functions are performed relative to this *Time* and the *Date* (see above). Therefore, an effort should be made to keep them accurate. The *Time* is used as a reference for initiating measurements and for sampling. The Measure Time (MeasTim) and Sample Time (SampTim) settings can be found under the measurement schedule (Menu Path=SYSTEM SETUP\MEASUREMENT SCHEDULE) menu. The 8200 compares its time with these times to determine whether or not to start sampling and measuring. Changing the time affects only when the next sampling or measuring cycle will start. It will not stop the current functions. However, altering the time setting may cause the 8200 to skip a sampling or measuring cycle if the new time set skips the interval or does not permit the current functions to complete before the next interval begins. See Chapter 3-12 for examples of setting the time.

UnitID

UnitID N - Unit Name

The *Unit ID* is used by the software to uniquely identify the 8200 to the user and to other systems in a network. It is also used to identify the data source for data dumped to the RAM Card and serial port. The *Unit ID* can be up to 8 alphanumeric characters. The first four characters are used by Sutron software as part of DOS file names when creating

a file of the data. While alphanumeric characters are allowed in the *Unit ID*, blank spaces are not. The reason for this is that embedded blanks can cause the software to malfunction or cause DOS to create files which cannot be accessed.

> Note: do not use spaces, decimal points or other special characters in the Unit ID. It may cause you to be unable to communicate with an 8200 or use the file created when data is dumped.

When using an internal or external modem the *Unit ID* becomes the user name you enter to login. When using a speech modem the *Unit ID* is used to speak the ID of the station in alarm or dial in messages. If the *Unit ID* contains numbers then the number will be spoken to identify the unit, if the *Unit ID* contains letters, then the letters are converted to numbers (based on the touch tone keypad order) and spoken as numbers. For this reason you may prefer to use a numeric *Unit ID* when using a speech modem. (For more information on setting this and any of the following menu items, see Chapter 3-7)

VIEW DATA

VIEW DATA *V - View Sensor Data*

VIEW DATA is a sub-menu with four fields: LIVE READINGS, NEWEST READINGS, OLDEST READINGS, and Alarm Status. These fields provide a way to view both current and logged sensor data. The menu appears as:

```
View Sensor Data Menu
  L - Live Data
  N - Newest Data
  O - Oldest Data
  A - Alarm Status
Choose:
```

(See separate heading VIEW DATA for complete information)

DUMP DATA

DUMP DATA *U - Upload/Download Data*

DUMP DATA contains a sub-menu with a selection of commands that can be used to initiate the uploading or downloading of data to, or from a RAM Card or other device. When using a test set, the menu will also contain functions for transferring the setup and basic program between the test set and the 8200 (see Chapter 7, page 7-12).

DUMP DATA\Auto Dump

Auto Dump *A - Auto Dump*

Auto Dump allows the 8210 to automatically dump data to a PCMCIA RAM Card which is inserted when the 8210 is turned on with ON/OFF. This simplifies the process of extracting data from an 8210 to a one-button operation. Insert the card and press ON/OFF, check the status, and when done remove the card. The status will remain on the display until the card is removed. Unlike a normal dump, an unformatted RAM Card will be automatically erased. The following messages are possible:

Complete XXXK	Transfer was successful (K = 1024 bytes data)
More Data XXXK	Transfer complete, more data available, remove card, insert another RAM Card, and press ON/OFF again.
Ram Failure	Could not read or write the ram card.
End of Data	No more data to dump Change Start Date?
No Ram Card!!!	8210 cannot detect the ram card
Need Ram > XXXK	Ram card is not large enough to hold even one days worth of data. The Ram card is already full - you will need to erase it first before you can reuse the card.
WriteProtect	The card cannot be written without changing the write protected switch on the card.

DUMP DATA\Erase Ram Card

Erase Ram Card *E - Erase Ram Card*

Prepares a PCMCIA RAM Card to be written to by the 8210 and erases any existing files on the RAM Card. The format placed on the card is “technically” a floppy disk compatible DOS FAT file format with one big file called RAMCARD.RCD. RAMCARD.RCD can contain multiple data and setup dumps. This format can be read directly by laptops and card readers which have the standard PCMCIA file system drivers loaded. RAMCARD.RCD can be copied to the PC where individual dumps can be extracted using the RAMCARD utility, or it can be operated on directly.

RAMCARD.RCD is a binary file and should only be operated on by the RAMCARD utility.

DATA\Ram Card

Ram Card *C - Send to Ram Card*

By inserting a PCMCIA RAM Card into the front panel socket and setting this command (use the SET button), selected data will transferred from the 8200 to the RAM Card. New data is always appended after any existing data on the RAM Card. A single RAM Card may contain data dumps and setups from one or more 8210's. Once a RAM Card fills up, it will have to be erased inorder to reuse the card (be sure to copy important data off the card first!).

The 8200 will transfer as much data from the log as will fit onto a RAM Card. Data will be transferred beginning from the start date either up to, but not including the current date, or, through the end of the log, depending on the setting of the Log Dump field in the EEROM Setup sub-menu (see below, page 4-16). If Log Dump is set to ALLBIN the dump will include all of the data in the log. If *Log Dump* is set to DAYBIN the dump will terminate at the end of "yesterday".

The following are some of the status messages that may be displayed after the 8200 attempts a data transfer to the ram card:

Complete XXXK	Transfer was successful (K = 1024 bytes data)
More Data XXXK	Transfer complete, more data available Insert another RAM Card, and press SET again.
Ram Failure	Could not read or write the ram card.
End of Data	No more data to dump Change Start Date?
No Ram Card!!!	8200 cannot detect the ram card
Need Ram > XXXK	Ram card is not large enough to hold even one days worth of data. The Ram card is already full - you will need to erase it first before you can reuse the card.
WriteProtect	The card cannot be written without changing the write protected switch on the card.
NeedErase	The card has not been formatted by an 8210 and cannot be written. Use the Erase Ram Card to erase and format the card.

DUMP DATA\Read Card Setup

Read Card Setup *R - Read Setup from Ram Card*

Read Card Setup is used to restore a complete EEROM setup from a RAM Card which had a setup saved on it with the Write Card Setup option. You will be able to select from a list of all the setups stored on the card. Pressing the SET key, will cause the 8210's complete setup to be restored. The following are possible messages:

Complete	--	Successful, Setup copied and burned
No RAM Card!!!		Ram card not installed, or inaccessible
EEROM Failure	--	Cannot write to the EEROM, needs repair
Bad Setup	--	Setup is incompatible, or not present

DUMP DATA\Serial Port

Serial Port *S - Send to Serial Port or Modem*

This command will cause the 8200 to transfer data to the RS-232 serial port (or modem) at the dump rate set in the EEROM setup menu (see below, page 4-16).

Data will be transferred beginning from the start date up to, but not including, the current date, or, through the end of the log, depending on the setting of the *Log Dump* field in the EEROM Setup sub-menu (see below page 4-17). If *Log Dump* is set to *ALLBIN* the dump will include all of the data in the log. If *Log Dump* is set to *DAYBIN* the dump will terminate at the end of the previous day's cycle.

When you press S, the 8200 will prompt "Press ENTER to Start, A for ASCII, or ESC to Abort". If you are using Sutron's TS8210 software, you will also be prompted to select a transfer protocol. The default is receive/YMODEM. If you simply press ENTER, the software will begin a YMODEM receive. The 8200 will name the file as xxxxMMDD.LOG where xxxx is the first four letters of the *unitID*. If a file already exists with this name, you will be prompted to either replace the file or enter a unique file name.

> Note: make sure the EEROM *Log Dump* option is set to ALLBIN or DAYBIN so you can receive the file in binary format..

You may also use PROCOMM or other communications software to receive the data from the 8200. When you see the prompt "Press ENTER to Start, A for ASCII, or ESC to Abort", use the functions built-in to you program to receive the file. With PROCOMM, you would press PGDN and then select YMODEM.

The X/YModem dumps of the data can take considerable time depending on the size of the log and the dump speed. If you are on-site and want the fastest dumps of data, you can run TS8200, the original 8200 test set software. This program supports a fast transfer from the 8200 that includes a single 16-bit checksum at the end of the data. When dumping the data to TS8200, the following messages can be displayed:

Complete	Transfer was successful, ACK received
Failed	Checksum was bad, NAK received
No Response	Complete but neither ACK or NAK received
End of Data	No more data to dump Change Start Date?
No Connect	Terminal is not connected. Check cable?

If you receive a "No Response" or a "Failed" message you should dump the data again in case part of the data was lost. If you miss the message altogether, you can always check a log file by running the CHKLOG program supplied with the 8200 on the LOG file.

You should always use TS8210 or other X/Ymodem programs to dump the log over telephone lines. TS8200 should only be used on-site and when the normal TS8210 dump takes too long.

You can also dump data directly into a program which can "capture" serial data to a disk file (most communications programs support this capability). The drawback is that the data is not checked for accuracy when you use this method. If you want an ASCII dump of the data, start your capture program and press A when you are prompted with "Press ENTER to Start, A for ASCII, or ESC to Abort".

DUMP DATA\Start

Start ***D - Start Date***

This is the date from which data will be dumped to the uesr's choice of RAM Card, serial port, or modem. The date cannot be set to before the earliest date in the log, or later than the latest date. After data is dumped, the start date will be automatically updated to the date of the next data to be dumped.

DUMP DATA\Write Card Setup

Write Card Setup ***W - Write Setup to Ram Card***

Write Card Setup is used to write a copy of the 8210 EEROM to a RAM Card. The RAM Card can then be taken to another 8210 and cloned by using the Read Card Setup option (above). Pressing the SET key will cause the setup to be written to an installed ram card. The following are possible messages:

Complete	--	Successful, Setup written to ram card
No RAM Card!!!		RAM Card not installed, or inaccessible
Ram Failure	--	Write operation failed. RAM Card may be bad
WriteProtect		The RAM Card is write protected
NeedErase		The RAM Card needs to be erased

Upload/Download Data\Protocol (PC Only)

-- ***P - Protocol***

The default serial transfer protocol can be set to either XMODEM or YMODEM. If available use the YMODEM option which features faster transfers (1024 bytes versus 128 bytes at a time), automatically supplies the filename, and doesn’t roundup the file size.

Upload/Download Data\Transfer Basic Program (PC Only)

-- *B - Transfer Basic Program*

Transfer Basic Program is used to send (upload) or receive (download) the basic program to the 8200.

To use this function you must be running software on the test set that supports XMODEM or YMODEM such as TS8210 or PROCOMM

When this function is selected, the 8200 will prompt:

Ready for X/Ymodem Upload/Download (press ESC to abort)

If you are running TS8210, the transfer program menu will also be displayed. This menu allows you to select between Receive and Send. You will also be able to specify a file name if you are sending to the 8210. If you are receiving the basic program and using YMODEM, the program will automatically name the setup file as *unitid.BAS*. If this file already exists on disk you will be prompted to replace the file or enter a unique file name..

If you are running a different communications program, you will need to instruct your program to upload or download the basic program.. For example, when running PROCOMM, this is done by pressing PGUP to perform an upload (send basic program to the 8200) or PGDN to perform a download (receive basic program from the 8200). Other software will have a similar function. If you are downloading the basic program, select the YMODEM protocol so the software will be able to automatically name the file for you. If sending a file, you may use either XMODEM or YMODEM.

Make sure you have set the BasicSize option in the EEROM Setup menu (see page 4-16) to a large enough size to accommodate your program, otherwise the 8200 will not be able to receive the whole program. The 1K byte default is only large enough for very small programs. For example: If MSDOS shows the file size of your program to be 5269 then the BasicSize must be set to at least 6 (k bytes).

Upload/Download Data\Transfer Raw Ram Card Image (PC Only)

-- *I - Transfer Raw Ram Card Image*

Transfer Raw Ram Card Image is used to send (upload) or receive (download) the entire contents of the RAM Card. This option could potentially be used to recover data from an accidentally formatted or damaged RAM Card, or to transfer a software upgrade to a RAM Card.

Upload/Download Data\Transfer Setup (PC Only)

-- *T - Transfer Setup*

Transfer Setup is used to send (upload) a setup to an 8200 or receive (download) a setup from an 8200.

> To use this function you must be running software on the test set that supports XMODEM or YMODEM such as TS8210 or PROCOMM

When this function is selected, the 8200 will prompt:

Ready for X/Ymodem Upload/Download (press ESC to abort)

If you are running TS8210, the transfer program menu will also be displayed. This menu allows you to select between Receive and Send. You will also be able to specify a file name if you are sending to the 8210. If you are receiving the setup and using YMODEM, the program will automatically name the setup file as *unitid.SET*. If this file already exists on disk you will be prompted to either replace the file or enter a unique file name.

If you are running a different communications program, you will need to instruct your program to upload or download the setup. For example, when running PROCOMM, this is done by pressing PGUP to perform an upload (send setup to the 8200) or PGDN to perform a download (receive setup from the 8200). Other software will have a similar function. If you are downloading the setup, select the YMODEM protocol so the software will be able to automatically name the file for you. If sending a file, you may use either XMODEM or YMODEM.

Sutron's TS9000 software can also be used to send and receive 8200 setups. By selecting the transfer setup option in TS9000, the "Transfer Program Menu" will automatically pop-up, and you can either send a program (setup) to, or get one from the RTU (8200). In one transmission, this method captures both the setup information and basic program in a form that is compatible with Sutron's Base Station and LOS Radio software. You may be interested in using this option if you want to capture a setup for future downloading over a LOS radio system. Otherwise the XMODEM method is recommended.

Upload/Download Data\View Ram Card Directory (PC Only)

-- *V - View Ram Card Directory*

Display a list of all the files stored on the RAM Card and their status. Each file on the RAM Card has a checksum. If a file has become corrupted the file will be marked as BAD. In addition a message will be displayed if the battery on the RAM Card is low or the card is write protected.

Upload/Download Data\Ymodem Ram Card File(s) (PC Only)

-- *Y - Ymodem Ram Card File(s)*

Allows the 8210 to be used as a card reader or writer. All the files on a RAM Card can be downloaded to a PC, or selected file(s) can be appended to the RAM Card. Xmodem is not supported because it can not automatically handle file naming.

EEROM SETUP

EEROM SETUP *E - EEROM Setup Options*

EEROM SETUP is a menu item. These items affect some EEROM values that control the way the 8200 communicates and also contains some calibration and timing values.

EEROM SETUP\AnalgDelay

AnalgDelay *A - Analog Delay (10*ms)*

AnalgDelay sets the amount of time (in ms*10) that the 8200 will pause after applying power to the +5 volt excitations, but before making an analog measurement. This time gives the analog section a chance to stabilize as well as allowing the sensor some warm-up time. The value should not be set to less than 2 (20ms) because of settling times.

EEROM SETUP\AutoKey

AutoKey *K - Auto Startup Keys*

The Auto Startup Keys are a string of keys that are automatically executed when the front panel is turned on (similar to Autoexec.bat files in the DOS environment). This makes it possible for the 8200 to automatically go to a particular menu item when the front panel is turned on. The startup keys can instruct the 8200 to pause at a specific menu item and even turn the display off, thus making the 8200 tamper resistant.

When using the front panel, press the SET to enter the set mode, then press the ▲ arrow key to move into the alpha field. Any of the below letter options may then be set.

The keys are defined as follows:

U	Up arrow (moves the display up one level)
D	Down arrow (moves the display down one level)
R	Right arrow (moves the display right one level)
L	Left arrow (moves the display left one level)
S	Set key (changes options and edits fields)
P	1 second pause (pauses the display window for one second)
O	Off (once enabled, the "O" can only be removed with a test set)

Example: Setting the *AutoKey* string to DDDDDDR would automatically position the 8200 display (at power-up) on the LIVE READINGS menu item.

EEROM SETUP\BasicSize

BasicSize — *B - Basic Prog Size (KB)*

BasicSize defines the amount of memory that the 8200 will set aside for a BASIC program. The BASIC program will use this memory for its code and memory array. This memory is allocated from the log memory space. Therefore, changing the size of the Basic program will cause the 8200 to clear the log. The 8200 will prompt:

OK to erase log?

To cancel the change of the *BasicSize*, press any key other than SET. Any BASIC program in memory is also cleared whenever the BasicSize changes. Make sure you set the *BasicSize* to a large enough value to accommodate your entire program to prevent the end of the program from being truncated. Also, be sure to allow some extra room for expanding the program in the future.

EEROM SETUP\Com Rate

Com Rate — *C - Com Baud Rate*

The *Com Rate* setting determines the baud rate for an external modem or terminal attached to the internal Com port or for the second radio in a system with two LOS radio boards.

EEROM SETUP\DateFmt

DateFmt — *Date Format*

MDY the date will be displayed in the format MM/DD/YYYY
DMY the date will be displayed in the format DD/MM/YYYY
YMD the date will be displayed in the format YYYY/MM/DD

EEROM SETUP\Dump Rate

Dump Rate — *T - Transfer Baud Rate*

Dump Rate sets the baud rate for the serial port when dumping data to the serial port from the front panel dump data menu option (see the *DUMP DATA* Menu, above page 4-3 for more information). This does not affect the baud rate when dumping to a modem or

when dumping using a test set. Normally, the *Dump Rate* and *User Rate* are set to the same speed.

EEROM SETUP\Enter Reqd

Enter Reqd *E - Enter Key Required*

This setting affects use of Test Set software only. *Enter Reqd* may be set to ON or OFF. When set to ON, the Enter key on the keyboard must be depressed in order to select a menu option. When OFF, a single keystroke of the appropriate letter is all that is needed to select an option. It is useful to have Enter Reqd ON when working with the 8200 over a modem to prevent line noise from accidentally choosing a menu option.

NOTE: this does not affect the operation of the enable, config, alarm, measurements sub-menus.

EEROM SETUP\Log Dump

LogDump *D - Log Dump Mode*

Log Dump is used in conjunction with the *Dump Data* menu (see above page 4-3) to control both the format and amount of dumped data. Options include *ALLBIN, DAYBIN, ALLASC*, and *DAYASC*. The *ALLBIN* option configures the 8200 to dump all data in the log up to the current time. The day option requests that only complete full days are to be dumped (up to the end of the previous day). The BIN option sets the dumping of data to the binary format typically used by Sutron software such as TS8210. The *ASC* option selects the ASCII data transfer mode which can be used to dump data to the screen or to a serial capture program. The *ASC* option is rarely used, because it can always be selected when dumping the data. The *DAY* option can be used to prevent overlapping data in the dump files. *ALLBIN* is the default value of the field.

EEROM SETUP\PowerDelay

PowerDelay *O - Power On Delay (10*ms)*

PowerDelay is used in conjunction with the *PwrMode* setting in the *MEASUREMENT SCHEDULE* (see below page 4-76). *Power Delay* affects the amount of time (in ms*10) that the 8200 will pause after turning switched +12V power on and before taking a reading (when *PwrMode* is set to *MEASURE*).

EEROM SETUP\PressDelay

PressDelay — *P - Pressure Delay (10*ms)*

PressDelay sets the amount of time (in ms*10) that the 8200 will pause after applying power to the pressure port but before taking a measurement. This time setting gives the amplifiers a chance to stabilize as well as giving the sensors time to respond to the excitation voltage. The value should not be set to less than 5 (50ms) because of amplifier slew rates.

EEROM SETUP\Radio Rate

Radio Rate — *R - Radio (LOS) Rate*

The *Radio Rate* setting determines the baud rate for the first installed internal LOS radio in the 8210. If a second LOS radio board is installed then its rate is determined by *Com Rate*.

EEROM SETUP\SDI Rate

SDI Rate — *S - SDI-12 Baud Rate*

The *SDI Rate* sets the data baud rate for the SDI-12 interface. Although, by specification this rate is 1200 baud, the rate may be changed to support higher/lower throughput. Do not change this value unless you are connecting an SDI sensor which also supports a baud rate other than 1200.

EEROM SETUP\Serial

Serial — *M - Serial Port Mode*

The Serial Port is the RS-232 port on the front panel. This port can be set to operate in several different modes. These modes are:

USER	An PC may be connected to the RS232 port to set up the 8200 using menus.
SENSOR	A smart sensor can wake up the 8200 (by asserting request to send), and send an ASCII floating point number followed by a carriage return. This number will be stored in the database value for the SERIAL sensor and can be logged. Most serial sensors are polled (such as the AIR barometric pressure sensors) and you will only need to use this option in a custom configuration.

LOGGER	Data are written to the port as they are logged. A printer or computer may be connected to accept the data.
PROTOCOL	The port can be connected to a Sutron 9000 (either direct or over a radio link) and communicate with protocol messages.
RADIO	The port will be used to drive an external radio through an RF Modem. The 8200 will expect Sutron Standard Protocol communications. Both two way and one way communications are supported. Alarm transmissions can be triggered by limits set on any sensor and sent to the external radio.
MODEM	The 8200 will emulate a Hayes compatible modem using the internal telephone modem. By connecting a standard computer terminal to the RS-232 port an 8200 can be used to communicate with another computer. NOTE: Once this mode has been entered, there is no way to return to User mode except by the front panel.
EXTMODEM	This is used when you will connect an external modem to the RS232 port. The 8200 cannot use the external modem to dial out (a clever Tiny Basic program might be able to dial out in a limited fashion). A DIP switch or a software option usually has to be set in the modem to ignore DTR (data terminal ready is pin 20 on a DB25). Usually modems will not answer the phone if DTR is not asserted, and since the 8200 is usually powered down it does not assert DTR. The CD (carrier detect is pin 8 on a DB25) must be wired to CTS (clear to send pin 4 on the 8200 DB9) so that the modem will wake up the 8200 when a call comes in.
OFF	The 8200 will not automatically use the serial port (conduct a login session if a terminal is connected). It will; however, still be available for data transfer, serial sensor, or SDI-12 operations

EEROM SETUP\TimeFmt

TimeFmt — *Time Format*

NORMAL Time ranges from 00:00 to 23:59:59. Data logged at exactly midnight will have the Time stamp of 00:00:00 of the next day

24HOUR Time ranges from 00:00:01 to 24:00:00. Data logged at exactly midnight will have the Time stamp of 24:00:00.

Users must reset (not necessarily change) the following parameters in order for the Time Format Command to take effect:

SYSTEM SETUP/MEASUREMENT SCHEDULE:	**BasTim** (Basic Run Time) **MeasTim** (Measurement Time) **PwrTim** (Power Time) **SampTim** (Sample Time)
GOES SETUP:	**DatTmST** (Data Time ST) **DatTmRR** (Data Time RR)

EEROM SETUP\TimeLimit

TimeLimit *L - User Time Limit (sec)*

After a specified amount of time without any user activity on the front panel, the 8200 normally turns off the front panel display to conserve battery power. *TimeLimit* sets the amount of time (in seconds) a user can be logged in to the 8200 without pressing a key. Longer times may be appropriate for certain situations, but keep in mind that battery power is being used up.

If you are connected and logged into an 8200 using a PC, *TimeLimit* will force an automatic logout if the period of inactivity reaches TimeLimit.

EEROM SETUP\User Rate

User Rate *U - User Baud Rate*

The *User Rate* setting determines the baud rate for the serial port when it is in the *PROTOCOL, USER, LOGGER, RADIO, MODEM, EXTMODEM*, or *SENSOR* modes. Automatic baud rate detection is not supported.

GOES SETUP (GOES Models Only)

GOES SETUP G - GOES Radio Setup

Basic setup for self-timed reporting is controlled through the *GOES Radio Setup* sub-menu.
Eleven fields must be defined in order to make self-timed transmissions. The fields are:

TX Mode	Transmission mode, self-timed, random-reporting, or both
Format ST	Data message format
Internatl	Enable selection of international channels for 8200s used outside of the USA
Carrier ST	Message carrier length, short or long
SatID	Assigned ID code for this station (from NOAA-NESDIS)
Channel ST	Assigned self-timed channel
Time ST	Assigned self-timed reporting time
Rate ST	Assigned self-timed reporting interval
#Data/TX ST	No. of data items for each parameter taken from 8200 log and encoded in each self-timed transmission
DatTmST	Synchronization time - the time at which to begin extracting data from the log in order to build a message
DatInST	Data interval - the time interval between readings from the 8200 log (equal to or a multiple of MeasInt)

GOES RADIO SETUP\# Data/TX ST

#Data/TX ST 4-#Data Items/TX

No. of data items per self-timed transmission
The *#Data/TX ST* field specifies how many of each designated parameter will be sent. A designated parameter is one which has been assigned to the self-timed reporting group by placing a one (1) in the second position of its Groups field. (See step 2 for setting up self-timed reporting - Designating sensors for inclusion in self-timed messages Also see the Groups value under the *ALARM OPTIONS* Menu, Chapter 4, page 4-60 for more information on Groups).

For example, the normal GOES operating cycle is 4 hours. Many users collect 15 minute data for all parameters, or 16 values per cycle. If you want each transmission to contain only the data from the last 4-hour period then *#Data/TX ST* should be 16. If you wanted to transmit 4 hours of redundant data (current 4 hours plus previous 4 hours) then *#Data/TX ST* would be 32. Because *#Data/TX ST* applies to each sensor, 16 or 32 is correct no matter how many sensors are selected to be in the transmission.

Some care must be taken in assigning *#Data/TX ST* so that messages do not become too long. A normal GOES transmission window is only 1 minute wide. The data transmission rate is 100 bits/second. Practically speaking only 40 to 45 seconds of the window may be used because of drift in the transmitter clocks and the fixed header required on each message. Thus only 4000 to 4500 bits may be sent each reporting

interval. The more conventional method for measuring message length is 8-bit bytes, leaving 500 to 560 bytes for each reporting interval.

The number of bytes in a message is determined by several things:

* The selected message format (SHEF or BINARY),
* The interval between self-timed transmissions
* Data/TX ST
* The number of designated parameters

Estimating the number of bytes in a BINARY format message. Each designated parameter value (each number) transmitted requires 3 bytes. Estimate the required number of bytes by multiplying the number of designated parameters by *#Data/TX ST*. For example, if you have:

a. designated water level, air temperature, and battery voltage, for a transmission, and,
b. you have set *SDatInt* to 15 minutes,

then, in a standard 4-hour cycle you would want to set *#Data/TX ST* to 16 and accumulate 48 values for transmission. (3 designated parameters * 4 values/hour * 4 hours) The 48 values would require 48 * 3 = 144 bytes. Thus a *#Data/TX ST* of 16 is acceptable (144 bytes is less than 1/3 of the available message length of 500 to 560 bytes.

Estimating the number of bytes in a SHEF format message. Estimating the number of bytes in a SHEF format message is considerably more complicated than for the BINARY format. Messages are composed of readable ASCII characters, each of which requires one byte. Message length is a function of:

* the interval between self-timed transmissions
* *#Data/TX ST*
* number of designated parameters
* no. of characters used in each SHEF code
* no. of characters used for each parameter value

The number of bytes per designated parameter must now be computed depending on the logging setup.

Consider again the example of 3 designated parameters logged at 15-minute intervals for a 4-hour period. Assume that the SHEF code for each parameter requires two bytes. Allow two additional bytes for spaces and separators. Allow 1 byte for sign and one byte for a decimal point if required. (presence or absence of a decimal point is determined by the number of right digits used for logging a parameter.) Add an additional byte for each digit in the number you will transmit. For example, a single water level reading might appear in the message as:

GH:+43.75

Nine bytes have been used and one additional byte should be added for the space between this value and an adjacent one. Four hours of such messages will require 10 times *#Data/TX ST* or 10 * 12 = 120 bytes. If all three parameters were encoded in the same

way a message would be 3 * 120 or 360 bytes. Two thirds of the available bytes have been used with only 3 parameters! This example illustrates how the SHEF format can take up a large amount of transmission space.

GOES RADIO SETUP\Carrier ST

Carrier ST *C - Carrier*

The *Carrier ST* field determines the form of the beginning of transmitted messages. Demodulation equipment at receive sites varies in capability for acquiring carrier and synchronizing with incoming messages. The 8200 can send messages with two widely used forms of carrier and clock signals. The *Carrier ST* may be set to SHORT or LONG. When set to SHORT, messages are preceded by 0.5 second of carrier and 0.5 second of clock signal. When set to LONG, messages are preceded by 5 seconds of carrier and 2.5 seconds of clock. The SHORT option is the standard carrier for random-reporting messages.

GOES RADIO SETUP\Channel ST

Channel ST *1-Channel*

The *Channel ST* field contains the channel identification number assigned to a particular station by NOAA-NESDIS. The channel is selected by pressing SET when *Channel ST* is in the display window. Use the arrow keys to move right and left and to select appropriate numbers to set the channel. Press SET again when you have completed the number.

GOES RADIO SETUP\DatInST

DatInST *6-Data interval*

The *DatInST* field determines the time interval between values selected from the log for a self-timed transmission. The purpose of this field is to allow users to precisely control which data from the log are transmitted. When *DatInST* is set equal to the interval that the data is logged, the self-timed transmission will transmit data starting with the most recent data logged and continue with each previous value. If *DatInST* is some multiple of the logged data interval, the transmission will skip over some values. In this case, the *DatTmST* specifies which values get transmitted.

Example: The following example shows what data is transmitted at 11:18 for a station with *MeasInt*=00:15:00, *#Measmnt/Log*=1, *#Data/TS ST*=3, *DatInSt*=00:15:00 (15 minute data), *DatTmST*=00:00:00 (don't need *DatTmST* because *DatTmST = MeasInt*). The data remains the same for any transmission made between 11:15 and 11:29. Note that the first value is the one the transmitter (running at 11:18) finds when searching the log backwards.

10:00	10.7	
10:15	10.8	
10:30	10.9	
10:45	11.0	third value in message
11:00	11.1	second value in message
11:15	11.2	first value in message

Example: The following example shows what data is transmitted at 11:18 for a station with *MeasInt*=00:15:00, *#Measmnt/Log*=1, *#Data/TS* ST=3, *DatInSt*=01:00:00 (hourly values), *DatTmST*=00:00:00 (send top of the hour data). The data remains the same for any transmission made between 11:00 and 11:59. Note that the first value is the one the transmitter (running at 11:18) finds when searching the log backwards for data at the top of the hour.

8:45	10.2	
9:00	10.3	third value in message
9:15	10.4	
9:30	10.5	
9:45	10.6	
10:00	10.7	second value in message
10:15	10.8	
10:30	10.9	
10:45	11.0	
11:00	11.1	first value in message
11:15	11.2	

GOES RADIO SETUP\DatTmST

DatTmST *5-Data Time*

When the 8200 is set up to log more data than it transmits, the *DatTmST* field lets you select the time of the data to send. This situation arises when *DatInST* does not match the interval at which the data is logged. For example, if the log has 15 minute data in it and you want to send hourly data, *DatTmST* lets you select which of the four 15 minute values gets sent. In this example, *DatTmST*=00:00:00 would select the data logged at the top of the hour, *DatTmST*=00:15:00 would select the data logged 15 minutes into the hour and so forth.

In situations where you want to send data at the same interval that it is logged, *DatTmST* has no affect and should be left at 00:00:00.

Example: Refer to the examples for *DatInST* to see how *DatTmST* operates when it is set to 00:00:00.

Example: The following example shows what data is transmitted at 11:18 for a station with *MeasInt*=00:15:00, *#Measmnt/Log*=1, *#Data/TS* ST=3, *DatInSt*=01:00:00 (hourly values), *DatTmST*=00:30:00 (send half-hour data). The data remains the same for any

transmission made between 11:30 and 12:29. Note that the first value is the one the transmitter (running at 11:18) finds when searching the log backwards that was logged on the half-hour.

8:30	10.2	third value in message
8:45	10.2	
9:00	10.3	
9:15	10.4	
9:30	10.5	second value in message
9:45	10.6	
10:00	10.7	
10:15	10.8	
10:30	10.9	first value in message
10:45	11.0	
11:00	11.1	
11:15	11.2	

GOES RADIO SETUP\Format ST

Format ST — *F - Format (ST)*

The *Format ST* field determines how data from the 8200 log will be encoded prior to transmission. The available options are SHEF (Standard Hydrologic Exchange Format) and BINARY. SHEF format embeds SHEF parameter codes in ASCII messages. BINARY format uses 6-bit binary encoding and messages are positional with no parameter codes. BINARY format is much more efficient. Both formats are described in detail in Appendix D.

NOTE: The SHEF codes which are embedded in a message are set by changing the names of the sensors in the Master Sensor List in the Enable Sensors sub-menu. After you have enabled a sensor by pressing SET, press the ▶ right arrow key. The cursor will begin flashing under the first character of the sensor name. Use the [^]/ ▼ up/down arrow keys and the ▶ right arrow key to change the sensor name to the SHEF code for the sensor. Press SET when done.

GOES RADIO SETUP\Internatl

Internatl — *I - International*

GOES channels 1 through 99 and 101 through 199 are available for U.S. domestic assignment. When *Internatl* is OFF you may select any of the available domestic channels as assigned by NOAA-NESDIS. International channels are assigned the numbers 1 through 33. You may select these channels by turning Internatl ON. Additionally, Meteosat channel assignments (1 through 33) and frequencies can be used by turing Internatl to MSAT. Use the SET key to toggle the setting.

GOES RADIO SETUP\Rate ST

Rate ST *3-TX Rate*

The *Rate ST* field contains the reporting interval assigned to a particular station by NOAA-NESDIS. This interval is normally 4 hours for US domestic stations. Use the same procedure to set this Time as was used for the *Time ST* field.

GOES RADIO SETUP\SatID

SatID *S - Satellite ID*

The *SatID* field contains the 8-digit station ID assigned to a particular location by NOAA-NESDIS. The ID is keyed in two parts by pressing SET when *SatID* is in the display window. Use the arrow keys to move right and left and to select appropriate letters/numbers to set the first four characters of the ID. Press SET again and use the arrow keys to fill in the remaining four characters. Press SET a third Time to complete the *SatID*.

GOES RADIO SETUP\Time ST

Time ST *2-TX Time*

The *Time ST* field contains the reporting Time assigned to a particular station by NOAA-NESDIS. These times are in Universal Coordinated Time (Formerly Greenwich Mean Time or GMT). If you are keeping Time in any U.S. standard Time format you MUST convert this Time to UCT Time. It is much better practice (and safer) to set the Time in the 8200 to UCT (GMT).

WARNING: If this Time is set incorrectly you will make transmissions in a Time window which is not yours. You will then be in violation of the operating rules of the GOES system.

The *Time ST* is set by pressing SET when *ST-Time* is in the display window. Use the arrow keys to move right and left and to select appropriate numbers to set the Time. Press SET after completing each sub-field of the Time (hours, minutes, and seconds).

GOES RADIO SETUP\TXMode

TXMode *T - Transmit Mode*

The *TX Mode* field controls whether the 8200 will transmit on the selected self-timed channel, the selected random-reporting channel, or both. Select the desired mode by pressing the SET key.

GOES RADIO SETUP\Random Setup Menu

GOES Radio Random Setup Menu

Turning on random reporting and setting the reporting intervals is nearly identical to the steps required to set up for self-timed reporting. The setup for random reporting is controlled through the *GOES Radio Setup* sub-menu.

Nine fields must be defined in order to make random transmissions. The fields are:

TX Mode	Transmission mode, must be set to random-reporting, or both
Channel RR	Assigned random reporting channel
RN Rate	Normal or "base" interval between random transmissions
RA Rate	Alarm interval between random transmissions
#TX/Alarm RR	Number of attempts made for each alarm (random) transmission
AlmInRR	Time interval between the attempts at alarm (random) transmissions
#Data/TX RR	No. of data items for each parameter taken from 8200 log and encoded in each random transmission
DatTmRR	Synchronization time - the time at which to begin extracting data from the log in order to build a message
DatInRR	Data interval - the time interval between readings from the 8200 log (equal to or a multiple of MeasInt)

GOES RADIO SETUP\Random Setup Menu\# Data/TX RR

#Data/TX RR *6 - # Data Items/TX (RR)*

Number of data values from each parameter in a group. The *#Data/TX RR* field specifies how many values of each parameter in a group will be sent. Some care must be taken in assigning *#Data/TX RR* so that messages do not become too long (see Chapter 7,page 7-5 for more on self-timed transmissions). Random transmissions should average no more than 3 seconds long. The data transmission rate is 100 bits/second. Practically speaking only 2 seconds of the message may be used because of required clock, carrier, and ID bits. Thus only 200 bits may be sent in each random message. The more conventional method for measuring message length is 8-bit bytes. Twenty-five bytes may be sent during each reporting interval.

All random transmissions are binary format. The number of bytes in a message is determined by:

#Data/TX RR
number of parameters in a group

Recall that three bytes are required for each number (parameter value). A random message can hold 25/3 or approximately 8 or 9 values. *#Data/TX RR* times the number of parameters assigned to a group should not exceed 9 on the average.

For example, if a random reporting group contains both water level and cumulative rainfall (2 parameters), and the *#Data/TX RR* is 1, then a random message will contain one water level and one rainfall value. If *#Data/TX RR* is 4, then 4 values of water level and 4 values of rainfall will be sent. A value of *#Data/TX RR* of 5 would become too large and would result in truncated messages.

GOES RADIO SETUP\Random Setup Menu\#TX/Alarm RR

#TX/Alarm RR ***4 - # TX/Alarm (RR)***

Number of transmissions per alarm. The *#TX/Alarm RR* field determines the number of transmissions (burst) made after a group's alarm trigger first goes into alarm state. The purpose of this burst of transmissions is to ensure that an alarm-triggered random transmission will "get through". The transmissions will be separated by AlmInt (next paragraph). A value of 2 or 3 transmissions should be adequate for most applications. Use the SET key and the arrow keys to change the value of this field. *#TX/Alarm RR* applies only to the initial set of transmissions following an alarm. Any subsequent transmissions will be spaced at the "alarm rate" and will be single transmissions.

GOES RADIO SETUP\Random Setup Menu\AlmInRR

AlmInRR ***5 - Alarm Interval (RR)***

Time interval between transmissions. The *AlmInRR* field determines the amount of Time (average) that will elapse between transmissions caused by a group trigger sensor first moving into alarm state. This field should not be set to less than 4 minutes which is the typical value for this field. Use the SET and arrow keys to change the value of this field.

GOES RADIO SETUP\Random Setup Menu\Channel RR

Channel RR ***1 - Channel (RR)***

Random-reporting channel. The *Channel RR* field contains the random reporting channel identification number assigned to a particular station by NOAA-NESDIS. The channel is selected by pressing SET when *Channel RR* is in the display window. Use the arrow keys to move right and left and to select appropriate numbers to set the channel. Press SET again when you have keyed in the correct number.

GOES RADIO SETUP\Random Setup Menu\DatInRR

DatInRR *8 - Data Interval (RR)*

The *DatInRR* field determines the time interval between data items selected from the log for a random or alarm transmission. The purpose of this field is to allow users to precisely control which data from the log are transmitted. When *DatInRR* is set equal to the interval that the data is logged, the random transmission will transmit data starting with the most recent data logged. If DatInRR is some multiple of the logged data, the transmission will skip over some values. In this case, the DatTmRR specifies which values get transmitted.

DatInRR works just like *DatInST*. For examples, refer to *DatInST*.

> Note: if #Measmnt/Log is >1, the 8200 transmits the last measured value and then follows it with data based on *DatTmRR* and *DatInRR*.

GOES RADIO SETUP\Random Setup Menu\DatTmRR

DatTmRR *7 - Data Time (RR)*

When the 8200 is set up skip over some of the logged data in a random transmission, the *DatTmRR* field lets you select the time of the data to send. This situation arises when *DatInRR* does not match the interval at which the data is logged. For example, if the log has 15 minute data in it and you want to send hourly data, *DatTmRR* lets you select which of the four 15 minute values gets sent. In this example, *DatTmST*=00:00:00 would select the data logged at the top of the hour, *DatTmRR*=00:15:00 would select the data logged 15 minutes into the hour and so forth.

In situations where you want to send data at the same interval that it is logged, *DatTmRR* has no affect and should be left at 00:00:00.

DatTmRR works just like *DatTmST*. Refer to the examples for *DatTmST* for more information.

> Note: if #Measmnt/Log is >1, the 8200 transmits the last measured value and then follows it with data based on *DatTmRR* and *DatInRR*.

GOES RADIO SETUP\Random Setup Menu\RA Rate

RA Rate *3 - TX Alarm Rate (RR)*

Alarm random reporting rate. The *RA Rate* field contains a Time value indicating the average amount of Time allowed between random transmissions for all groups whose

group triggers are in alarm state. For example, if you want to have a report from a group which is in alarm state every hour you would set *RA Rate* to 1 hour. The same cautions concerning transmission collisions applies to *RA Rate* as applies to *RN Rate* (see above).

GOES RADIO SETUP\Random Setup Menu\RN Rate

RN Rate ***2 - TX Normal Rate (RR)***

Normal or "Base" random reporting rate. The *RN Rate* field contains a Time value indicating the average amount of Time allowed between random transmissions for all groups when the group triggers are not in alarm state. For example, if you want to have a report from a group twice per day, set *RN Rate* to 12 hours. (Be aware that because of potential collisions on the random channels you may have to set *RNRate* to 6 to 8 hours to average two transmissions per day after collision loss.)

INSPECT SYSTEM

INSPECT SYSTEM I - Inspect System and Test

A special *Inspect System* sub-menu is provided which allows the user to quickly examine how the 8200 is setup and whether or not the unit is operating properly. Before leaving a field site, you may find this sub-menu to be useful in ensuring that a unit is properly programmed.

INSPECT SYSTEM\Bert LOS Radio (front panel only)

This option allows BERT (bit error rate test'ing) of one of up to three radios installed in an 8210 - an LOS radio modem board installed in slot 1, slot 2, or an external radio modem. An external radio connected to the RS-232 port must have the *EEROM SETUP\Serial*: option set to *PROTOCOL* or *RADIO*, otherwise you will receive the message: "No Radio.". Use *Select Radio* to choose which radio you would like to test.

The menu displays 5 different statuses as follows:

```
Line 1: L:ggggg,bbbbb CD
Line 2: L:ppp% eeeeeeee
Line 3: R:ggggg,bbbbb CD
Line 4: R:ppp% eeeeeeee
Line 5: mail message
```

ggggg is the good message count, bbbbb is the bad message count, CD is visible if carrier is detected, ppp is the percent good (100*ggggg/(ggggg+bbbbb)), and eeeeeeee is the error distribution decribed later. Lines 1 and 2 contain the "L"ocal status, the status of the 8200. Lines 2 and 3 contain the "R"emote status, the status of the base station or 8200 set by the PROTOCOL SETUP\Master option. Line 5 contains the last mail message received by your 8200. To clear a local or remote status press ◄. To request that the remote status be updated, press ►. To send a BERT message to the remote press ▲. To request that a BERT message be sent from the remote to you press ▼. To view the next status line press SET. When you are done, press ON OFF.

The BERT test as implemented in the 8200 sends or receives 256, four byte mini-blocks containing "DLE ESC upcount downcount", where upcount increments from 0 to 255 and downcount decrements from 255 down to 0 for a total of 1024 bytes. When a good 4 byte block is received a "good count" is incremented. Bad or missing blocks are not directly detected instead they are inferrred. For instance if the block #100 was just received and the previous block received was #94 then the "bad count" would be incremented by 5 because blocks "#95,96,97,98,99" are missing. The BERT software also maintains an error distribution. This is a set of 32 bits representing 256 blocks (each bit represents 256/32 or 8 blocks) where block #0 thru #7 is the most significant bit. The error distribution is used to tell whether errors are happening at the beginning of the block, the end, or randomly distributed. The value is reported in hexadecimal by the 8200 such that 8000000 represents an error in block(s) 0-7 at the beginning of the message; 00000001 represents an error in block(s) 248-255 at the end of the message; FFFFFFFF represents errors thru-out the message; and 0000000 represents no errors.

ADVANCED BERT INFORMATION:

Note, the BERT message is not an SSP message although it is designed to not be confused with an SSP message. This means that a BERT message will be received by all stations who can hear it, and that BERT messages cannot be sent thru a SSP store-and-forward smart-repeater. To test a station on the other side of a repeater, request a BERT message from that repeater, then request stats from the field unit. To test a station thru multiple repeaters REP1 and REP2 to unit UNITNAME, a side-effect must be used. Simply, address an SSP message to "REP1_REP2_~" When the repeater REP2 tries to send the message to unit "~" it will substitute a BERT message for the original message. Then you will need to set the Master name back to "REP1_REP2_UNITNAME" and request remote BERT statistics.

Lastly, BERT testing is also possible thru a modem port, but it cannot be initiated by the 8200.

```
1 ' The following Basic program can be used to send a BERT message out the COM1:
2 ' port of a PC out a Base Station Radio or to an 8200 directly connected.
10 OPEN "COM1:1200,N,8,1,CS,DS" FOR OUTPUT AS #1
20 SLEEP 1
30 FOR i = 0 TO 255
40 PRINT #1, CHR$(16); CHR$(27); CHR$(i); CHR$(255 - i);
50 NEXT i
60 SLEEP 1
70 CLOSE #1
```

INSPECT SYSTEM\Clear Status

Clear Status *C - Clear Status*

The *Clear Status* function clears out error and communication status messages. Checksums are also set to zero. To recompute them you must use the Selftest option. The number of resets is not cleared by this function.

INSPECT SYSTEM\Display Status

Display Status *D - Display Status*

Display Status gives you a look at what the system is doing. Pressing SET on the front panel, or pressing "D" in the *Inspect System* Menu starts the status report. You will see a variety of system status information scroll across the display. To increase the scrolling rate, press the ▶ right arrow key. To decrease the scrolling rate press the ◀ left arrow key. To return to the normal scroll rate, press the SET button.

If using a Test Set, initiate the Display Status to view the system status information. This option may report one or more of the following:

No System Errors	-- No errors detected
Rom Error	-- ROM Error, uninitialized? or very serious
Ram R/W Error at XXXX	-- Address of bad RAM byte
EEROM Write Error at XXXX	-- Address of bad EEROM byte
EEROM CheckSum Error	-- Bad EEROM or system error
TERM, MODEM, RADIO	RX: 5/5, 0 bad -- Protocol information, includes device name, number of messages received, number of messages seen, number bad, number of transmissions, number of attempts, and number failed TX:10/10, 0 bad
Resets: XXXX	-- Number of system resets
ROM CheckSum: XXXX	-- CheckSum of the ROM, (should not change)
EEROM CheckSum: XXXX	-- CheckSum of the EEROM
LOG Size: XXXK	-- Size of the log in K bytes
Recording Status: XXXXXX	Recording can be: Disabled, Waiting, PreAverage, Averaging #XX, PreMeasure, Measuring, or Logging
Modem Status:, Serial Status:, Radio Status:, Radio1 Status:, Radio2 Status:, Serial Status:, Goes Status:	Shows alarm status, transmission status, time of next and last transmissions for the device.
Local Bert Stats:, Remote Bert Stats:	Shows # good Bert packets, total Bert packets, and error distribution
Mail:	Last mail message received
Ram Card:	Battery status, size, and amount free
Battery Status: min = XXX, max = XXX	Min and max battery voltage based on any measurement whether through live reading, GOES transmission, or scheduled logging. Use Clear Status to re-initialize the min and max values.
(programmable)	A Tiny Basic program can display custom status messages. Line 65110 will be branched to for messages to be displayed to a terminal or modem, line 65111 is used for the front panel.

Status information appears in groups. Depending on your model, the groups may include:

* *SYSTEM STATUS*
* *Modem Status*
* *Recording Status*
* *GOES Status*
* *Transmit Status*

The *SYSTEM STATUS* group contains information related to all 8200 operations. Normally you will receive the message "No System Errors". If either of the messages "GOES Clock Stopped" or "GOES Clock Error" appears then contact customer service immediately, your GOES card might be in need of repair.

The *Recording Status* group contains information on logging operations. If recording is OFF the status will show as Disabled. If the 8200 is performing a logging operation the status may appear as one of the following:

* Waiting
* PreAverage
* Averaging
* PreMeasure
* Measuring
* Logging

All of these status indications are considered normal and simply indicate what the 8200 is doing at the Time the status check was performed.

The GOES Status group contains information on the status of the GOES transmitter. If no transmission is in progress the status will show as OFF. If the 8200 is performing a transmission the status may appear as one of the following:

* On
* Locking
* Carrier
* Xmit Timed
* Xmit Random
* Locked
* FwdPower

All of these status indications are considered normal and simply indicate what the 8200 is doing at the Time the status check was performed.

If the message Fail-safe Tripped appears then you must remove the 8200 from its case and perform the fail-safe reset procedure (or toggle recording to use the software method) described under initialization at the beginning of this chapter. If this message occurs frequently in the field, contact customer service for advise: common causes include power failure or a manual transmission within 60 seconds of a previous transmission. The 8200 automatically prevents other causes including: message too long (greater than 3 minutes), automatic transmissions too close together. In addition the 8200 will not transmit if the battery voltage drops below 10.5 volts. This voltage is tested 3 seconds before the scheduled transmission time.

The *Transmit Status* group contains information on what the 8200 plans to do next and what it has done. The Time of the next scheduled self-timed transmission and the Time of the last self-timed transmission are provided. These two items help determine if the unit is properly scheduled.

> Note: if you see the time of last transmission set to 3 seconds before the scheduled transmission time, the 8200 aborted the transmission because of the battery voltage being out of limits.

INSPECT SYSTEM\Enter SDI-12 Cmd

Enter SDI-12 Cmd *E - Enter SDI-12 Commands*

This option allows you to send commands to SDI-12 sensors. The commands you can use depend on the type of sensor. All SDI-12 sensors will respond with an identification string when the "0I!" (zero, letter-I, exclamation point) command is used. This works for sensors at address zero, for a sensor at another address replace the "0" with the correct address. Other general commands include "0M!" to initiate a measurement, and "0D0!", "0D1!", ..., "0Dn!" to read the measured data. From the terminal you must enter the "!" at the end of the command. With the front panel it is automatically added. Other commands specific to the sensor may include the ability to change calibration settings, set the address, or load readings.

INSPECT SYSTEM\GOES RADIO TEST

GOES Radio Test *G - GOES RADIO TEST*

The *GOES Radio Test* function allows you to send a test GOES transmission in either the random or self-timed mode. These transmissions are usually transmitted in to a dummy load and a watt meter to check the GOES radio operation and output power. Never send a transmission through the antenna to a self timed channel at a Time outside of your allocated Time slot. A 5-line, 400+ character ASCII message is sent to the channel and satellite ID as selected in the GOES Setup Menus. Recording will be turned OFF when sending a test transmission to prevent a conflict with a scheduled transmission.

The Send to Sutron option MAY ONLY be used upon request of Sutron customer service personel because channel 151 is not a public channel, unathorized use is illegal.

Send to Sutron sends a coded message (meant to help Sutron analyze system problems) on channel 151 using id: 01003438 which contains a status message containing the following:

satellite id,unit id,number of resets,min battery,max battery,goes tx count,A rom checksum,B eerom fail address,C average sample #,D nmi glitch count,E analog error count,F pressure error count,G a/d timeout count,H refererence error count,I tx (truncated) counts,J basic current line number,K basic error code,L basic error line number,M no tx (low battery) count,N no tx (lock detect) count,O no tx (goes setup) count,P goes clock error count,Q tx (started late) count,R tx (low battery) count,S tx (high battery) count <EOT>

The fields which are prefixed with the letters A thru S will only be sent if their value is non-zero to reduce transmission size.

ex: BEEFF00D,Site56,5,11.2,13.7,148,A32424,C31,K1,L50,S5

would tell us that of the 148 transmissions from platform BEEFF00D - there where 5 transmissions with high battery (S5), it is currently averaging sample number 31 (C31), and there is a basic error #1 (K1) at line 50 (L50).

INSPECT SYSTEM\M - Monitor SSP Communications (PC only)

Allows SSP messages to be decoded, and various test to be peformed The main display shows a list of options, the selected port and its status, the unit ID to send messages to, and the last mail message received. As SSP messages are received or sent status messages will be scrolled on the screen.

```
Monitor - [V]erbose, [D]isplay Status, [K]ey, [U]nkey, [M]ail, [P]ort
        Send [T]o, [R]equest Setup, [S]end Setup, [B]ert Options
Radio Port: 1, 1200, CD, Sending
Sending To: PCBASE
Last Mail  :  Did you get this?
```

[V]erbose	enables additional decoding messages
[D]isplay Status	displays the system status, and any accumulated radio and BERT statistics.
[K]ey	keys the radio transmitter
[U]nkey	unkeys the radio transmitter
[M]ail	sends a mail message to the selected destination
[P]ort	switches to other installed radio ports
Send [T]o	selects the destination for the [M], [R], [S], and [B] options
[R]equest Setup	requests the setup from the selected destination
[S]end Setup	sends the 8210's setup to the selected destination
ESC	exit the monitor
ENTER	redisplay the main display.

[B]ert Options brings up a sub-menu of options as follows:

```
Choose [S]end Bert, [A]sk for Bert, [L]ocal Clear, [R]emote Clear,
     [G]et Status or <ESC>:
```

[S]end Bert	send a 1KB test message to all units in line of site
[A]sk for Bert	request a 1KB test message be sent by the selected destination
[L]ocal Clear	clears the BERT statistics for the 8210
[R]emote Clears	requests that the selected destination clears its BERT statistics
[G]et Status	requests the BERT statistics from the selected destination

Bert statistics consist of number of good Bert packets received out of total, and an error distribution. Each Bert packet consists of 4 bytes. Each Bert message contains 256 packets or 1024 bytes. The error distribution is an indication of where errors are occuring in the message.

Turn to page 12-5 for detailed suggestions on how to use *M-Monitor Communications* to solve communications problems.

INSPECT SYSTEM\Perform Selftest

Perform Selftest *S - Perform Selftest*

Perform Selftest provides a way of initiating some of the built-in tests without going through a power-up sequence. The Selftest is started by pressing SET on the front panel or "S" in the Inspect System Menu. The Selftest performs the following tests:

RAM Test	Read/Write Test to RAM
EPROM Test	CheckSum of EPROM
EEROM Test	CheckSum of EEROM

INSPECT SYSTEM\Production Test

Production Test *P - Production Test*

The *Production test* function turns on all switched voltages to make it easier to measure and calibrate them. The test is activated by pressing SET at the *Production Test* setting. Voltages will be turned on for 60 seconds during the course of the test. The message "Begin Test..." will indicate test performance.

INSPECT SYSTEM\Select Radio (front panel only)

Selects the radio to be used by the *Test LOS Radio* or *Bert LOS Radio* options.

1 - First LOS radio modem board installed in slot 1.
2 - Second LOS radio modem installed in slot 2 or connected to the COM port.
3 - External radio modem board connected to RS-232 port.

INSPECT SYSTEM\T - Talk to Modem or Terminal (PC only)

This option allows a user on the test set to talk to a user on the internal telephone modem or visa-versa. If another user is not logged in you will receive the message: "Nobody else logged in.". Otherwise you will receive the message: "TALK MODE - - Press ESC To Exit". You may then enter any keys you wish and they will be sent to the other user and appear on their screen. In order for the other user to respond they must also choose the "*Talk to Modem or Terminal*" option also, you will not see any keys they press until that time.

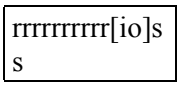
INSPECT SYSTEM\Test LOS Radio (front panel only)

This option allows testing of one of up to three radios installed in an 8210 - an LOS radio modem board installed in slot 1, slot 2, or an external radio modem. An external radio connected to the RS-232 port must have the *EEROM SETUP\Serial*: option set to

PROTOCOL or *RADIO*, otherwise you will receive the message: "No Radio.". Use *Select Radio* to choose which radio you would like to test.

This option is very useful for testing the integrity and reliability of a two-way radio link between two 8200's or an 8200 and the master station.

The test radio screen is broken up in to 3 fields:



Where the "rrrrrrrrrr" shows received characters as they come in, "io" shows characters received and transmitter characters being sent out, and "ss" shows a status of "CD" if carrier is detected or "TX" if you have keyed the transmitter.

Following is a list of valid options:

- ◄ Send a character and decrement the next character to send
- ► Send a character and increment the next character to send
- SET Key the transmitter
- ▲ Send a test mail message "This is a test mail message." to the master station
- ▼ Reset the next character to send to blank
- ON OFF Exit test mode

Turn to page 12-5 for detailed suggestions on how to use *Test LOS Radio* to solve communications problems.

INSPECT SYSTEM\Transmit Status (front panel only)

This option shows only the GOES transmitter information of the display status option. If all you need to do is check the Time of the next transmission, this is a quicker way than using Display Status. Note that this does not display the status of the failsafe. You must use Display status (or look at Main Menu\Recording) in order to display the status of the failsafe.

MODEM SETUP (Speech/Modem Models Only)

MODEM SETUP *M - Modem Setup Menu*

The *MODEM SETUP* Menu contains the settings needed to fully configure a modem equipped 8200 for data transmission. (See Chapter 7, above page 7-12)

MODEM SETUP\#1

#1,#2,,#3 *Phone #n*

These fields represent the telephone numbers to be dialed. The 8200 will cycle through each of the numbers until the alarms are acknowledged. The telephone numbers follow the same meanings as for Hayes "AT" compatible modems except for the addition of a MODE character. If the first character of the phone number is one of the following characters, the 8200 will change its telephone mode for the call. The default mode is voice mode:

V	VOICE Mode -- the default mode. The 8200 will use the dial-out string to determine what it speaks and how it handles the voice phone call.
S	SSP Mode -- the 8200 will send an SSP packet containing current data for any sensor with LOG ON. This is for use in communicating with a Sutron base station. If the base station ACKs the packet, the *ALERT* is acknowledged and the status changes to *ALARM*.
C	Computer Mode -- the 8200 will send the data out in ASCII in the same format as *VIEW ALARMS*. It will then prompt, Press <ENTER> to acknowledge alarm, and wait up to 10 seconds for enter to be pressed. If <ENTER> is pressed the *ALERT* is acknowledged and the status changes to *ALARM*. If it is not pressed, the 8200 continues its alarm notification with the next phone number.
D	Data Mode -- the 8200 will send the data out in the same format as *VIEW ALARMS*. It will then automatically acknowledge the alarm and change the status from *ALERT* to *ALARM* if a modem connection was made.

H Placing an “H” (Hayes command) before a phone number will allow Hayes commands to be added before the phone number. The dial command must also be included. For example, “HS8=30DT5551212,123” will set the S8 register (time to pause for a comma) to 30 seconds, DT will tell the modem to dial the phone number using touch tone, and the comma after the number will delay 30 seconds and then dial the rest (the 123). This sequence might be used to dial a pager and enter the code 123. The “H” option can be combined with other dial options, by placing the “H” after the dial option. For example, the “SHS11=200DT5551212” will send an SSP alarm using a long 200ms delay between touch tone digits.

DIALING COMMANDS

P Pulse Dial
, Pause
! Flash
/ Wait for 1/8th second
@ Wait for silence
W Wait for second dial tone

Example: The phone number SP17035551212 will cause the 8200 to pulse dial a base station at the phone number 17035551212

Example: The phone number C5551212 will dial up a computer that has a special program written to send the <ENTER> key after accepting the data.

Example: The phone number C5551212,,,,,12 will dial up a paging service and enter the message 12 to be sent to the pager. (Note, the number of commas will depend on the paging service.)

Example: The phone number 5551212 will cause the 8200 to dial the phone number and use the dial-out string to control what is spoken/done over the phone.

MODEM SETUP\AnswerMode

AnswerMode *A - Answer Mode*

DATA When this option is selected, the 8200 will answer the phone in the "data" mode; that is, it sends the answer tone to allow connection to a modem.

VOICE When this option is selected, the 8200 will answer the telephone and begin speaking the Dial-In Message.

VOICE & DATA	In this mode, the 8200 supports both voice and data communications. When the 8200 answers the telephone, it speaks the phrase ("Please press pound"). If you press the "#" key on the telephone, the 8200 will begin speaking the Dial-In Message. If you press the "*" key, the 8200 will immediately send the modem answer tone. If you do not press either key, the 8200 will wait for a pre-determined amount of time and then send the modem answer tone.
DATA & VOICE	In this mode, the 8200 answers with data carrier first for 5 seconds and then if a modem originate tone is not detected, the 8200 will switch to voice mode. This feature allows dual operation in situations where touch tone phones are not available.
BASIC	In this mode, the BASIC program has control over how the phone is answered and what is spoken. (See Chapter 10 for more information).

MODEM SETUP\Dial-In

Dial-In *I - Dial-In Message*

This field represents the message the 8200 will "speak" when it is called and answers in the VOICE mode. This message is actually a coded sequence of numbers and characters that controls what the 8200 speaks and what it does. When you look at this string it will make little sense to you unless you understand the basic rules needed to construct the message. The maximum length of the dial-in message is 128 characters.

Standard Messages

There is a way however to construct a Dial-In message without knowing the details of these message strings. Sutron has "canned" several *Standard Messages* into the 8200 which can be selected from the front panel. To use them you press the set key followed by the up arrow while the Dial-In prompt is displayed on the front panel. Each time you press the up arrow, the 8200 will display an abbreviation for a standard message. Pressing up arrow repeatedly will let you cycle through the messages. When you have the message you desire, press the SET key. The display will revert to its standard form displaying the message you selected in coded form.

The available *Standard Messages* are:

Arc	Speak archived or logged data for each of the sensors
Liv	Speak live data for each of the sensors
ArcMen	Speak archived data followed by the Speech Menu
LivMen	Speak live data followed by the Speech Menu
IdArc	Speak the station ID followed by archived data
IdLiv	Speak the station ID followed by live data
IdArcMen	Speak the station ID, archived data and speech menu
IdLivMen	Speak the station ID, live data and speech menu.

Those *Standard Messages* that include the menu will allow you to press keys on a touch tone phone to interact with the 8200.

Note: The standard dial-in messages do not include the prompt for the password and must be edited if password protection to the 8200 is wanted.

Remember: you will need to set SYSTEM SETUP\ALARM OPTIONS\Enable to ON (or other non-off state) for each sensor you want the 8200 to speak. IF this Enable is OFF, the 8200 will omit the sensor when speaking Live data or Archived data.

Build Your Own Message

Numbers

To speak a number (that is, actual numbers such as 1,2,3) simply typing the desired number into the string. All individual numbers must have "white space" (such as a space character) between them.

Example:

To instruct the 8200 to speak "five four three two one", enter the following dial-in (or dial-out) message, noting the spaces:

5 4 3 2 1

Words and phrases

Words and phrases are entered in a message string by typing the "@" symbol followed by the word/phrase number (see 7-52, 7-53). Alternatively, the ":" symbol may be used in place of "@". No white space is allowed between the "@" or ":" and the word/phrase number. If a number is to follow the word/phrase, white space is required between the word/phrase number and the actual number. No white space is required between phrases.

Example:

To program the 8200 to speak the phrase, "Welcome to the Sutron 8200", enter the following dial-in (or dial-out) message:

@182 2 :173:170 82 @29

Note that the "@" and ":" symbols are interchangeable in the above example. Also, 8200 is pronounced "Eighty-two:hundred", thus the #29.

NUMERIC LIST OF 8200 SPEECH PHRASES

0 (1/2 second of silence)
1 zero
2 one
3 two
3 to
3 too
4 three
5 four
5 for
6 five
7 six
8 seven
9 eight
10 nine
11 ten
12 eleven
13 twelve
14 thirteen
15 fourteen
16 fifteen
17 sixteen
18 seventeen
19 eighteen
20 nineteen
21 twenty
22 thirty
23 forty
24 fifty
25 sixty
26 seventy
27 eighty
28 ninety
29 hundred
30 thousand
31 point
32 minus
33 Please press pound.
34 Please enter password
35 For live data
36 For archive data
37 To acknowledge alarms
38 To enable alarms
39 To disable alarms
40 To enable data modem
41 To list
42 sensor names and numbers
43 sensors in alarm
44 To hang up
45 Please press
46 Please call again.
47 is not available.
48 Hello, Welcome to the Sutron 8200.
49 Thank you.
50 please
51 pound
52 press
53 star
54 o'clock
55 account
56 a
57 acknowledge
58 air
59 alarm
60 alert
61 analog
62 any
63 at
64 average
65 bars
66 barometric
67 battery
68 cancel
69 Celsius
70 centi-
71 change
100 command
101 continue
102 dam
103 data
104 degrees
105 direction
106 disable
107 -ed (make words past tense)
108 enable
109 enter
110 error
111 Fahrenheit
112 falling
113 feet
114 flood
115 gate
116 gage
117 height
118 -ing (add "ing" suffix)
119 hertz
120 high
121 hour

122 humidity
123 in
124 inches
125 incorrect
126 internal
127 is
128 kilometers
129 knots
130 Langleys
131 limit
132 level
133 low
134 mercury
135 meters
136 miles
137 mili-
138 no
139 normal
140 not
141 number
142 of
143 off
144 OK
145 on
146 out
147 outliers
148 password
149 per
150 percent
151 position
152 precipitation
153 pressure
154 radiation
155 rate
156 relative
157 reservoir
158 rising
159 run
160 -s (make words plural)
161 second
162 sensor
163 snow
164 solar
165 speed
166 stage
167 standard deviation
168 station
169 steady
170 Sutron
171 telephone
172 temperature
173 the
174 this
175 time
176 valve
177 Volts
178 warning
179 was
180 water
181 Watts
182 welcome
183 wind

Alphabetical List of 8200 SPEECH PHRASES

-ed (make words past tense)	107
-ing (add "ing" suffix)	118
-s (make words plural)	160
(1/2 second of silence)	0
a	56
account	55
acknowledge	57
air	58
alarm	59
alert	60
analog	61
any	62
at	63
average	64
barometric	66
bars	65
battery	67
cancel	68
Celsius	69
centi-	70
change	71
command	100
continue	101
dam	102
data	103
degrees	104
direction	105
disable	106
eight	9
eighteen	19
eighty	27
eleven	12
enable	108
enter	109
error	110
falling	112
Fahrenheit	111
feet	113
fifteen	16
fifty	24
five	6
flood	114
for	5
For archive data	36
For live data	35
forty	23
four	5
fourteen	15
gage	116
gate	115
height	117
Hello, Welcome to the Sutron 8200.	48
hertz	119
high	120
hour	121
humidity	122
hundred	29
in	123
inches	124
incorrect	125
internal	126
is	127
is not available.	47
kilometers	128
knots	129
Langleys	130
level	132
limit	131
low	133
mercury	134
meters	135
miles	136
mili-	137
minus	32
nine	10
nineteen	20
ninety	28
no	138
normal	139
not	140
number	141
o'clock	54
of	142
off	143
OK	144
on	145
one	2
out	146
outliers	147
password	148
per	149
percent	150
please	50
Please call again.	46
Please enter password	34

Special Characters

A variety of special characters are available to speak common messages. These characters are explained in the following table. The sensor number assignments are described in the preceding tables. Note that sensors 1 through 9 must be entered as 01 through 09 (two digits).

Example:

Assuming Sensor 1 is the water level, the current water level can be spoken with the following message:

n01:127r01u01

In the above example, the sensor name and units were stored in the "Prefix" and "suffix" of the Alarm menu. If these values are not programmed, the same message could be spoken as:

:180:132:127r01:113

SPECIAL CHARACTERS

iu	Speak information about unit ID
id	Speak information about Date
it	Speak information about Time
ia	Speak information 8200 Alarm Status ("in alarm" or "normal")
ir	Speak Recording Status ("On" or "Off")
la	Speak list of sensors in alarm
ln	Speak list of normal sensors (not in alarm)
lb	Speak list of both normal and alarm sensors
ll	Speak list of live readings from all sensors
vNN	Speak last recorded value of sensor NN
rNN	Read sensor NN and then speak value
nNN	Speak name of sensor NN
uNN	Speak units of sensor NN
tNN	Speak trend of sensor NN
aNN	Speak alarm status of sensor NN
cNN	Speak current value of sensor NN (Name, Value, Units)
oNN	Speak "old" (last archived) value of Sensor NN (Name, Value, Units, Trend, Alarm)
p	Ask for password, numeric or alpha, touch-tone key 2 = ABC, touch-tone key 3 = DEF, etc.
wN	Wait for any DTMF key to be pressed, repeat on "*", and acknowledge alarms if the key pressed was "N"
m	Enter speech menu system. Allows a user to acknowledge alarms, enable or disable alarm, hear current data, or hear stored data via the telephone.
*	Repeat marker. If user presses "*" key (or "#" symbol is in message), message will repeat from this point. If no "*" is in message, it will repeat from the beginning
#	Repeat (from beginning of message or "*" symbol until) "#" key is pressed
?NN	Read a new value for sensor number NN from the user. User enters the number with the DTMF keypad. "*" is used for a decimal point, and "#" is used to enter the number.

8200 SENSOR NUMBERS

Sensor Name	8200	8200A	8210
Analog 1	01	01	01
Analog 2	02	02	02
Analog 3	03	03	03
Analog 4	04	04	04
Analog 5	--	05	05
Analog 6	--	06	06
Analog 7	--	07	07
Analog 8	--	08	08
Pressure	05	09	09
Encoder 1	06	10	10
Encoder 2	07	11	11
Counter	08	12	12
Counter 1	09	13	13
Counter 2	10	14	14
Counter 3	11	15	15
Counter 4	12	16	16
Frequency	13	17	17
Frequency 1	14	18	18
Frequency 2	15	19	19
Frequency 3	16	20	20
Frequency 4	17	21	21
Wind Speed 1	18	22	22
Wind Speed 2	19	23	23
Wind Speed 3	20	24	24
Wind Speed 4	21	25	25
Wind Direction 1	22	26	26
Wind Direction 2	23	27	27
Wind Direction 3	24	28	28
Wind Direction 4	25	29	29
Water Level	26	30	30
Outliers	27	31	31
Deviation	28	32	32
Serial	29	33	33
Battery	30	34	34
Shaft8500	31	35	35
Rain	32	36	36
ORG100	33	37	37
ORG700	34	38	38
Timer1	35	39	39
Timer2	36	40	40
DataPack	37	41	41
Excitation	38	42	42
Ground	39	43	43
Reference	40	44	44
Amplifier	41	45	45
Optional	42	46	46
Goesclock	--	--	47
Out 1..8	--	--	48..55

Inp 1..12	--	--	56..67
SDI0_1..9	43..51*	47..55*	68..76
SDI1_1..9	52..60*	56..64*	77..85
SDI2_1..9	61..69*	65..73*	86..94
SDI4_1..9	70..78*	74..82*	95..103
SDI5_1..9	79..87*	83..82*	104..112
SDI6_1..9	88..96*	92..100*	113..121
SDI7_1..9	97..105*	101..109*	122..130
SDI8_1..9	106..114*	110..118*	131..139
SDI9_1..9	115..123*	119..127*	140..148

*add 1 to these numbers for GOES units. GOES units have the GOES Clock sensor (number 43 for the 8200, 47 for the 8200A

The speech menu

When the special character m is entered in a message string the 8200 will provide a pre-recorded speech menu which works with the DTMF decoder to allow the user to perform a variety of operations. The operations include:

- acknowledgment of alarms;
- enabling alarms;
- list sensor names and numbers;
- listen to live data readings;
- listen to archive data readings;
- list normal (not in alarm state) sensors;
- list sensors in alarm state;
- change programmable sensor data;
- enable data modem (if voice only); and,
- hang up the phone connection.

The exact phrasing of the menu system is provided below. After the 8200 has spoken each phrase in the menu it will wait for the user to press a key on his touch-tone telephone. The selected option will then be executed. A dial-in message of "Welcome to station xxx" or "Hello, Welcome to the Sutron 8200" (:48) followed by entry into the menu system makes a very simple and usable talking station.

PHRASES IN THE SPEECH MENU

- To acknowledge alarms please press 1
- To enable alarms please press 2
- To list sensor names and numbers please press 3
- For live data please press 4
- For archive data please press 5
- To list normal sensors please press 6
- To list sensors in alarm please press 7
- To change sensor data please press 8
- To enable data mode please press 9
- To hang-up please press 0
- Enter Command:

MODEM SETUP\Dial-Out (enable)

Dial-Out *D - Dial-Out Enable*

Dial-Out Enable

OFF	When this option is selected, the 8200 will not dial out based on alarm conditions.
ON	When this option is selected, the 8200 can dial out based on the alarm conditions programmed for each sensor.

MODEM SETUP\Dial-Out

Dial-Out (message) *O - Dial-Out Message*

This field represents the message the 8200 will speak when it dials out. The construction of the message is identical to that described previously for *DialIn*. Refer to the information on *Dial-In* for details.

DialOut has built-in messages available that are a little different from *DialIn*. The main difference for the built-in *DialOut* messages is that all the messages speak the ID and some messages make it possible to acknowledge alarms. The built-in messages are as follows:

IdArcAck	Speak the ID, archived data and all acknowledgment of alarms
IdLivAck	Speak the ID, live data and allow acknowledgment of alarms
IdArcMen	Speak the ID, archived data and speech menu.
IdLivMen	Speak the ID, live data and speech menu.

MODEM SETUP\Number Rings

Number Rings *N - Number of Rings*

This field indicates how many times the telephone should ring before being answered by the 8200.

MODEM SETUP\PhonePass

PhonePass *P - Phone Password*

The 8200 supports a password for voice and data communications. The password may be entered as a number or as a string of characters. The maximum length of the password is 5 characters or digits.

> NOTE: If characters are used, and the 8200 is used in voice mode, the letters "Q" and "Z" must not be used, as they are not available on the telephone keypad.

When you dial the 8200 with a telephone modem, the 8200 prompts for the "User Name" and "password". Enter the Unit Name of the 8200 for the User Name, and the Phone Password for the password.

When you dial the 8200 to interact with the speech synthesizer, the dial-in message must be set up to prompt for the password. This is done by entering a "p" into the dial-in message. (See Special Characters on page 4-47). The standard dial-in messages do not include the prompt for the password and must be edited.

This password is separate from the SYSTEM SETUP\Password which controls whether which is the password for the setup.

MODEM SETUP\Redial

Redial Delay *R - Redial Delay*

This field indicates the Time delay between telephone calls.

NOTE: FCC regulations require that if only one telephone number is called, the Redial delay must be at least 10 minutes.

PROTOCOL SETUP

PROTOCOL SETUP *P - Protocol Setup Options*

The *Protocol Setup* defines important information used when the system communicates using its internal or external radios. These communications use Sutron Standard Protocol (SSP), hence the name of the menu. One field in this setup, *Ack Delay*, also is used by the modem software when it communicates in SSP. See the *Protocol Setup* Menu for complete details (see below page 4-53).

PROTOCOL SETUP\# Retries

 # Retries *N - Number of Retries*

See *RetryIn* (above) for a description of how *#Retries* is used to control the number of re transmissions that are made when a sensor goes into Alert. If *#Retries* is set to 0, no re transmissions are made. A typical value for *#Retries* is 3.

PROTOCOL SETUP\ACK Delay

ACK Delay *A - ACK Delay (.1s)*

Ack Delay sets the Time that the 8200 will wait for an acknowledgment when sending an SSP message. Many SSP messages expect an acknowledgment from the receiving end to let the sender know the message was received without errors. With *Ack Delay* 100 (the default value), the Ack message must be received in 10 seconds. On radio systems with multiple repeater paths, *Ack Delay* should be much longer (about 10 seconds for each path).

This value is shared by both radio and telephone communications. If you are using both modes, set the value to the longer of the two response times.

PROTOCOL SETUP\CarrierDly

CarrierDly *C - Carrier Delay (.1s)*

Carrier Delay specifies the amount of Time the carrier must be on before the data is sent. The typical value for Carrier Delay is 10, meaning 1.0 seconds. The 8200 will key the transmitter, wait for the carrier delay period and then send data. The *Carrier Delay* affects both internal and external transmitters.

PROTOCOL SETUP\HW Handshake

HW Handshake *H - H/W Handshake on COM*

Enables CTS/RTS h/w handshaking on the COM port. This is useful if you are connecting an external high speed modem to the COM port. The 8210 will stop transmitting when CTS is dropped, and will drop RTS if it's receive buffer starts to fill up. The default is OFF.

PROTOCOL SETUP\Long Packets

Long Packets *L - Long SSP Packets*

Enables the 8210 to use long SSP packets (1024 bytes as opposed to 256 bytes). Long packets provide better performance and are the default. Reasons to use shorter packets include: very bad signal quality, -or- a need to repeat messages thru an 8200 which only supports short packets.

PROTOCOL SETUP\Master

Master *M - Master Name*

The *Master Name* is used to name the destination whenever the 8200 makes a transmission using the internal or external radio. For example, with Master Name set to BASE, the 8200 will format a packet with the destination of BASE when it makes the alarm transmission. The name can be a base station, another field station, or a base station through a field station.

PROTOCOL SETUP\ReplyDelay

ReplyDelay *R - Reply Delay (.1s)*

Reply Delay sets the Time that the 8200 will delay before replying to a message. Its default value is 0, meaning no delay. A value of 10 would cause the 8200 to wait 1 second after receiving a message before transmitting the reply. *Reply delay* is useful, if the system sending a request, needs a second or two to get ready for the reply.

PROTOCOL SETUP\RetryIn

RetryIn *3 - Retry Interval*

When a sensor goes into Alert, the 8200 will immediately make a transmission. If the ACK is received, the 8200 changes the sensor status to Alarm and will not attempt a retry. If no ACK is received and #Retries is >0, the 8200 will delay based on *RetryIn* and then try again. This continues until the number of attempts > #Retries.

The 8200 delay is actually a random delay based on *RetryIn*. With *RetryIn* set to 00:01:00, the delay will be anywhere from 0 and 60 seconds (00:01:00). Typically, *RetryIn* is a short Time of less than 10 minutes or so.

PROTOCOL SETUP\TA Rate

TA Rate *2 - TX Alarm Rate*

TA Alarm Rate sets the amount of Time between 8200 transmissions when a sensor is in the alarm state. For example, if you want to have a report from the 8200 every hour you would set TA Rate to 1 hour. If *TX Alarm Rate* is 00:00:00, no transmissions will be made.

Sensors must have *Alarm Setup*, *Enable = RADIO, SERIAL* or *BOTH* for the *TA Rate* to be used (*SYSTEM SETUP/ALARM OPTIONS*/]).

PROTOCOL SETUP\TN Rate

TN Rate *1 - TX Normal Rate*

This represents the Normal or "Base" random reporting rate. The *TN Rate* field contains a *Time* value indicating the amount of Time between transmissions from the 8200 when there are no sensors in the alarm state. For example, if you want to have a report from a group twice per day, set *TN Rate* to 12 hours. If *TX Normal Rate* is 00:00:00, no transmissions will be made.

Sensors must have *Alarm Setup*, *Enable = RADIO*, *SERIAL* or *BOTH* for the *TN Rate* to be used (*SYSTEM SETUP/ALARM OPTIONS*/]).

PROTOCOL SETUP\Use RS-485

Use RS-485 ***Use RS-485 w/SDI-12 - C***

Causes all SDI-12 measurements to be performed thru the RS-485 port and not the SDI-12 port. RS-485 (at this time) is an unoffical extension to SDI-12 which can greatly increase the distance a sensor can be installed from the recorder. All SDI sensors must be configured for either SDI-12 or RS-485, they cannot be mixed without a Tiny Basic program to toggle ***Use RS-485*** on and off.. The default is OFF.

SYSTEM SETUP

SYSTEM SETUP S - System Setup

The *System Setup* menu provides a way to perform most of the essential functions needed to set up an 8200. The items in the menu provide a means to set up the following submenus:

Measurement Schedules
Enable Sensors
Configure Sensors
ALARM OPTIONS
Basic Program
Change Password
Init Setup
Zero Counters

SYSTEM SETUP\ALARM OPTIONS

ALARM OPTIONS ALARM OPTIONS

The *ALARM OPTIONS* menu provides fields for defining:

- alarm limits
- speech prefix and suffix
- GOES transmission groups
- data reported by SSP Current data poll.

Whether or not you will have the 8200 detect alarms, it may still be important to enter values into some of the alarm fields.

Alarm conditions can be specifically defined for each enabled sensor. The 8200 can check a high limit, low limit, and rate-of-change limit for each enabled sensor. Deadband values are also available for each limit. Triggering of any of the sensor alarms can occur as a value goes over a limit or when it falls below the limit.

An 8200 with a speech modem can also check "trending" information. Trending determines whether the reading of a particular sensor is rising or falling. This information is particularly useful in "talking" stations when speaking water levels or barometric pressure; e.g. "the water level is 8.48 and rising", or the barometric pressure is 29.95 and falling" (for use with 8200 SPEECH Models).

As mentioned earlier, the *ALARM OPTIONS* do more than just control alarms:

- The GOES 8200 uses some of the alarm information to define its self-timed and random reporting groups.
- A speech 8200 uses the prefix and suffix to determine how to speak a particular sensor.

- Any 8200 communicating using SSP will use the Alarm Enable to include the sensor in the reply to a poll for current data

The options in Alarm will be used even though you may not have a need for alarms at a site (see 7-8 for more detailed information).

You set the *ALARM OPTIONS* in a manner similar to setting the Configuration options. From the front panel, the 8200 will display a sub-menu of sensors. Use the ▲ or ▼ front panels to select the desired sensor and press >. You will then be able to view the *ALARM OPTIONS* fields one at a time and set them as desired.

From the PC, the display will show a list of sensors on the left of the screen with ">" pointing to the first sensor as shown in the example below. A menu of commands is also shown at the top of the screen. The data shown on the right is the data for the selected sensor. To select another sensor, use the up and down arrow keys.

> Note: Units with speech/modems will have the additional fields Trend, Prefix and Suffix. Units with GOES will have the additional field Groups. The Groups are used to identify which sensors trigger random reports and which sensors are included in self-timed and random transmissions. The Enable field takes on additional values for speech/modems and GOES.

```
+-------------------------[ ALARM SENSOR OPTIONS ]-------------------------
-+
¦ Choose [U]p [D]own [E] [G] [C] [1] [2] [3] [H] [L] [R] [B]:
¦
+-----------------------------------------------------------------------------
-+

Active Sensors
> Analog4
  Pressure                        +-----------------------------------+
                                  ¦ Alarm Options                     ¦
                                  ¦    E - Enable                 OFF ¦
                                  ¦    C - Control                OFF ¦
                                  ¦    1 - High Alarm             OFF ¦
                                  ¦    2 - Low Alarm              OFF ¦
                                  ¦    3 - ROC Alarm              OFF ¦
                                  ¦ Alarm Limits                      ¦
                                  ¦    H - High Limit           0.000 ¦
                                  ¦    L - Low Limit            0.000 ¦
                                  ¦    R - ROC Level            0.000 ¦
                                  ¦    B - DeadBand             0.000 ¦
                                  +-----------------------------------+
```

SYSTEM SETUP\ALARM OPTIONS\Control

Control *C - Control*

OFF	*Control* options are disabled.
ON	*Control* options are enabled. When the sensor is in alarm, the switched +12V power on the terminal block will respond according to the setting of PWR. Mode in the Measurement Schedule sub-menu.

SYSTEM SETUP\ALARM OPTIONS\DeadBnd

DeadBnd *B - DeadBand*

This value provides a "dead band" to prevent multiple alarms from occurring when the sensor value is very close to the alarm limits. It is used in the detection of alarms based on *HiLev*, LoLev, ROCLev and Trend. The dead band should be set to a number larger than the typical instability of the sensor. For instance, if it is 25^{o} outside and your temperature sensor reports readings from 24.95^{o} to 25.05^{o} then you should set the sensor's dead band to a minimum of 0.05^{o}.

SYSTEM SETUP\ALARM OPTIONS\Enable

Enable *E - Enable*

Enable does much more than just turn on/off alarm detection for a sensor. For speech 8200's it allows you to enter prefix and suffix phrases for each sensor. For GOES 8200's it sets up the self timed and random reporting groups. The following are the values for *Enable* for all versions of the 8200:

OFF	Alarms are not enabled for this sensor. Other alarm setup information is not saved when this is OFF.
ON	Alarms are enabled for this sensor and/or other alarm setup information is saved.
EXT	(ALL 8200's) Alarms are enabled for this sensor and the 8200 will make transmissions through the RS232 front panel port. For this to work correctly, the port must also be set up in the EEROM menu for RADIO.
SMDM	(SPEECH/MODEM ONLY) Alarms are enabled for this sensor, and the 8200 will automatically dial out using the telephone modem based on the alarm condition.

GOES	(GOES ONLY) Alarms are enabled for this sensor and the 8200 will automatically include the sensor's readings in a random transmission from its group. If this sensor is the group alarm trigger, alarm transmissions will be scheduled when this sensor changes alarm state depending on the High, Low and ROC Alarms.
RAD	(LOS RADIO ONLY) Alarms are enabled for this sensor and the 8200 will make transmissions using the internal radio module.
"A&B"	Combinations are possible. For instance GOES&SMDM would cause alerts caused by this sensor to be sent to both the GOES and the Speech modem modules.
3-WAY	Alarm transmissions are made to both internal cards and the radio connected to the RS232 port.

Note: If *Enable* is OFF, the remaining options will not be saved. Be sure to set *Enable* to a value other than OFF in order to preserve the prefix, suffix, groups etc.

SYSTEM SETUP\ALARM OPTIONS\Groups

Groups (GOES Models)

Groups is a 4-position field (XXXX) used to designate what reporting groups a sensor belongs to. Place a one (1) in the second position of this field if the sensor is to be included in self-timed reports (ex: 0100), the other positions are used for random reporting groups.

Groups determine what sensor readings are sent together in messages. The 8200 supports up to 9 reporting groups. Group 1 is the self-timed group. Groups 2 through 9 are random-reporting groups, and 0 means blank or not used.

Membership in a group is designated by placing a group number (a digit "0"-"9") in one of the positions of *Groups*. A sensor can belong to as many as 4 different groups by using all 4 positions in the field.

The first position of the *Groups* field is special. When a group number is placed in the first position of a sensor's *Groups* field it indicates that the sensor is the "trigger" for that group. If the sensor's Enable field is set to TX, when the sensor goes into alarm state the 8200 will schedule a random transmission for the group in the first position. All of the members of a group can be designated as triggers if desired.

The remaining three fields are not positional, but by convention the second one is used to designate membership in the self-timed group. Place a one (1) in the second position if the sensor is to be included in self-timed messages. The remaining two fields should be 0 (blank), or a group number.

The user is free to select his own group numbers for random reporting. You may have a single reporting group called "7" or three groups numbered 3,4, and 8. That is, there is no importance attached to any specific number other than 1.

The following example illustrates the use of two overlapping random-reporting groups along with self-timed reporting. In this example the two random reporting groups are 3 and 4. Group three contains water level, dissolved oxygen, and water temperature. Group four contains dissolved oxygen, water temperature, and air temperature. The trigger for group 3 is water level. The trigger for group four is dissolved oxygen. All five parameters are to be included in self timed transmissions (group 1).

Parameter 1 - Water Level	Enable = TX	
	Groups =3100	trigger and member for group 3, member of group 1 (self-timed)
Parameter 2 - Dissolved Oxygen	Enable = TX	
	Groups = 4130	trigger and member for group 4, member of group 1 (self-timed) and group 3
Parameter 3 - Water Temperature	Enable = ON	
	Groups = 0134	not a trigger value, member of group 1 (self-timed), group 3 and group 4
Parameter 4 - Air Temperature	Enable = ON	
	Groups = 0140	not a trigger value, member of group 1 (self-timed) and group 4
Parameter 5 - Wind Speed	Enable = ON	
	Groups = 0100	not a trigger value, member of group 1 (self-timed)

SYSTEM SETUP\ALARM OPTIONS\High Alarm

High Alarm *1 - High Alarm*

High Alarm controls whether the 8200 will generate an alarm based on a comparison with the *High Limit*. The High Alarm test compares the sensor value with HiLev plus *DeadBnd*. If the sensor value is greater than or equal to *HiLev* plus *DeadBnd*, the sensor is in High Alarm. When the sensor value falls below *HiLev* minus *DeadBnd*, the sensor is no longer in High Alarm. This High Alarm test will be made only if High Alarm is not set to OFF.

High Alarm can have the following options:

OFF	Alarm detection is not based on the *HiLev*.
ABOVE	High Alarm checks will be made. Transmit alarm when the sensor goes above *HiLev* plus *DeadBnd* (**into** alarm)

BELOW	High Alarm checks will be made. Transmit alarm when the sensor goes below *HiLev* minus *DeadBnd* (**out of** alarm)
BOTH	High Alarm checks will be made. Transmit alarm both when the sensor goes **into** alarm and when it goes **out of** alarm

Note: The same test is done regardless of whether *High Alarm* is set to ABOVE, BELOW or BOTH. These different settings control when to notify you of the alarm, not how the data is tested.

(See *HiLev* on page 4-62 and also Understanding Alarms and Alerts in Chapter 7 for more information)

SYSTEM SETUP\ALARM OPTIONS\HiLev

HiLev — *H - High Limit*

The 8200 alarm status is set to ALARM when the sensor value is greater than or equal to *HiLev* plus the dead band value. The alarm is cleared when the value is less than *HiLev* minus *DeadBnd*.

The Above/Below options for *High Alarm* do not change this sense; these options merely determine whether the 8200 will dial out based on entering or leaving the alarm condition.

Example: With *HiLev* set to 1.5 and *High Alarm* set to Above and *DeadBnd* set to .1, the system will detect alarms as follows:

Time	Value	Alarm Status
00:15:00	1.2	NORMAL
00:30:00	1.5	NORMAL
00:45:00	1.6	ALARM (1.6 >= 1.5 + 0.1), transmission made
01:00:00	1.5	ALARM
01:15:00	1.4	NORMAL (1.4 <= 1.5 - 0.1), no transmission made because High Alarm was set to ABOVE, not BOTH

SYSTEM SETUP\ALARM OPTIONS\LoLev

LoLev — *L - Low Limit*

An alarm is generated when the sensor value is less than *LoLev* minus *DeadBnd*. The alarm clears when the sensor value is greater than or equal to *LoLev* plus *DeadBnd*.

Example: With *LoLev* set to 1.5 and *Low Alarm* set to BOTH and *DeadBnd* set to .1, the system will detect alarms as follows:

Time	Value	Alarm Status
00:15:00	1.6	NORMAL
00:30:00	1.4	ALARM and transmit (1.4 <= 1.5 - 0.1)
00:45:00	1.5	ALARM
01:00:00	1.6	back to NORMAL and transmit (1.6 >= 1.5 + 0.1
01:15:00	1.4	NORMAL

SYSTEM SETUP\ALARM OPTIONS\Low Alarm

Low Alarm *2 - Low Alarm*

Low Alarm controls whether the 8200 will generate an alarm based on a comparison with the *Low Limit*. The *Low Alarm* test compares the sensor value with *LoLev* minus *DeadBnd*. If the sensor value falls below *LoLev* minus *DeadBnd*, the sensor is in Low Alarm. When the sensor value goes above *LoLev* plus *DeadBnd*, the sensor is no longer in High Alarm. This test will be made only if *Low Alarm* is not set to OFF.

Low Alarm can have the following options:

OFF	Alarm detection is not based on *LoLev*.
ABOVE	Low Alarm checks will be made. Transmit alarm when the sensor value goes above *LoLev* plus *DeadBnd* (**out of** alarm).
BELOW	Low Alarm checks will be made. Transmit alarm when the sensor value falls below *LoLev* minus *DeadBnd* (**into** alarm).
BOTH	Low Alarm checks will be made. Transmit alarm both when the sensor goes **into** alarm and when it goes **out of** alarm

Note: The same test is done regardless of whether *Low Alarm* is set to ABOVE, BELOW or BOTH. These different settings control when to notify you of the alarm, not how the data is tested.

(See Understanding Alarms and Alerts in Chapter 7 for more information)

SYSTEM SETUP\ALARM OPTIONS\Prefix/Name

Prefix/Name *P - Prefix (Speech/Modem Only)*

The *Prefix* provides the 8200 with the number of a word or phrase to speak to identify the sensor data value. When the prefix is non-zero, the 8200 will speak the prefix followed by the value. The number for the prefix can be any of the words or phrases defined for

the speech module (see table-1, page 4-43 for a complete listing of the 8200 words and phrases). It can also be one of the following phrases specifically prepared for the prefix:

200	Air Temperature
201	Barometric Pressure
202	Gauge Height
203	Relative Humidity
204	Reservoir Level
205	Snow Level
206	Solar Radiation
207	Valve Position
208	Water Level
209	Wind Direction
210	Wind Run
211	Wind Speed

Example: With *Prefix* set to 208 and a *Suffix* set to 113 the 8200 will speak the following for a sensor value of 1.56.

"Water Level is one point five six feet"

SYSTEM SETUP\ALARM OPTIONS\ROC Alarm

ROC Alarm *3 - ROC Alarm*

The *ROC (Rate of Change) Alarm* controls whether the 8200 will generate an alarm based on the rate of change of a sensor. *ROC Alarm* has the following options:

OFF	Rate of Change alarm detection is not enabled for this sensor.
ABOVE	A Rate of Change alarm is generated if the absolute value of the difference between the current data and a previous value is above the ROC Level plus the dead band.
BELOW	A Rate of Change alarm is generated if the absolute value of the difference between the current data and a previous value is below the ROC Level minus the dead band. (this is used to generate alarms when a sensor is not changing or changing slower than desired.)

NOTE: a value for *ROC Level* must be entered in order to select this option.

The previous value can be either the last collected data or the last transmitted data depending on the setup. See *ROC Level* below.

SYSTEM SETUP\ALARM OPTIONS\ROCLev

RocLev — *R - ROC Level*

An alarm is generated when the current sensor value differs from a previous sensor value by more than this amount plus the dead band value. The previous value used in the comparison can be one of two values depending on how the 8200 is set up:

- last alarm transmitted value isused as the previous value for sensors enabled to transmit over a radio or GOES
- last measured value isused as the previous value for sensors enabled to transmit over the telephone or not enabled to transmit.

The difference between the two is significant. When the comparison is done based on the value transmitted in the last alarm transmission (RANDOM transmission for GOES), the 8200 will make alarm transmissions whenever a sensor value changes by an appreciable amount regardless of the time frame of the change. This allows a base station data base to be kept up to date in real time. This method is not used with the speech/modem because it would result in phone calls when there may not actually be a real emergency condition. When the comparison is done based on the last measured value, the time frame is important. Only when the change of value exceeds *RocLev* in the specified time, will an alarm be generated.

Example: The 8200 is set up with *RocLev* = 0.5 and *ROCAlarm* = ABOVE: The table shows the alarm state for both a telephone system and a radio system.

Time	Value	Telephone	Radio
00:15:00	1.2	NORMAL	NORMAL
00:30:00	1.4	*NORMAL*	ROC ALARM if last tx value is <0.9
00:45:00	1.6	NORMAL	NORMAL
01:00:00	1.8	NORMAL	NORMAL
01:15:00	2.4	ROC ALARM	ROC ALARM (2.4 - 1.4 >=0.5)

SYSTEM SETUP\ALARM OPTIONS\Suffix/Units

Suffix/Units — *S - Suffix (Speech/Modem Only*

The *Suffix* provides the 8200 with the number of a word or phrase to speak to identify the sensor units of measurement. When the *Suffix* is non-zero, the 8200 will speak the suffix after speaking the value. The value for the *Suffix* can be any of the words or phrases defined for the speech module (see table-1, page 4-43 for a complete listing of the 8200 words and phrases). It can also be one of the following phrases specifically prepared for the suffix:

200	Centimeters
201	Degrees Celsius
202	Degrees Fahrenheit

203	Feet per Hour
204	Feet per Second
205	Inches of Mercury
206	Inches per Hour
207	Inches per Second
208	Kilometers per Hour
209	Miles per Hour
210	Meters per Second
211	Milibars

See the example under *Prefix*.

SYSTEM SETUP\ALARM OPTIONS\Trend

Trend — *T - Trend (SPEECH/MODEM ONLY)*

The *Trend* value is only available on units with the Speech/Modem installed. *Trend* controls whether the 8200 will check the trend of the sensor. Trending determines whether the reading of a sensor is rising, falling, or steady. *Trend* can have the following options:

OFF	Trending information (i.e., "rising" or "falling") is not recorded.
ON	Trending information is recorded and may be reported with the data.

Trend is initialized to STEADY when recording is turned on. The *Trend* check is done at the time a value is measured. The check compares the current value with the value last measured. The trend of a sensor will not change unless two consecutive trend checks agree on a new state. The *Trend* will report STEADY if the change is less than the deadband (for at least two samples).

Example: The 8200 is setup to report trending on a sensor and has a deadband of 0.10:

00:15:00	2.55	
00:30:00	2.65	seems to be rising (first time rising detected)
00:45:00	2.80	yes, it is rising, set state to RISING
01:00:00	2.85	now it may be steadying off (change less than deadband)
01:15:00	2.90	yes, it is steady, set state to STEADY
01:30:00	2.85	it is still steady (change less than deadband)
01:45:00	2.75	it may be falling
02:00:00	2.70	no, it is not falling (change less than deadband)
02:15:00	2.6	it may be falling
02:30:00	2.5	yes it is falling, set state to FALLING

SYSTEM SETUP\CONFIG SENSOR

CONFIG SENSOR C - Configure Sensors

This Sub-Menu displays a list of all the sensors that are enabled in the 8200 and allows important configuration information to be set. If a sensor has not been enabled, it will not show up in the list to be configured. The benefit of this is that it allows the user to configure only those sensors that have been enabled.

To view or change the configuration of a sensor from the front panel, use the up/down arrow keys to display the name of the desired sensor. Notice that following the name of each sensor are 6 blanks that can contain the abbreviations Me, Lg, and Av. Me means that Measure is ON, Lg means that Log is ON, and Av means that Averaging is ON. Since measuring and averaging are mutually exclusive, you will never see a sensor with both Me and Av.

To see the full configuration of make changes, press the right arrow key. The display will then display the configuration fields and permit the values to be changed. Use the up/down arrow keys to go through all the different fields of the configuration.

If you are using the PC a list of all the enabled sensors will be displayed on the left side of the display with a pointer ">" in front of the first sensor as shown below. The current configuration for the sensor will be displayed on the right of the screen identified with a label and the key required to make a change to the values. Use the up/down arrows to move the cursor to different sensors and note the information on the right change. Note that some of the configuration fields cycle or toggle between values each time the menu key is pressed. For example, Measure changed OFF to ON or ON to OFF each time "M" is pressed. For other items such as Slope, a cursor will appear when the item is selected so a new number can be typed in. For example, when you press "S", the cursor will jump to the Slope field and let you enter a new value for slope. Press [ESC] to abort a change to a item once it has been selected.

On the following page we have recreated a screen shot from a PC running the TS8210 software.

```
+---------------------------[ CONFIGURE SENSORS ]-------------------------
-+
¦ Choose [U]p [D]n [M]es [L]og [A]vg [I]nt [V]al [S]lo [O]fs [E]lev [R]d:
¦
+-------------------------------------------------------------------------
-+
                                        +-------------------------------+
  Active Sensors                        ¦ Configuration                 ¦
> Analog4                               ¦    M - Measure            OFF ¦
  Pressure                              ¦    L - Log                OFF ¦
                                        ¦    A - Average            OFF ¦
                                        ¦    I - Interval      00:00:00 ¦
                                        ¦ Calibration                   ¦
                                        ¦    V - Value         1008.886 ¦
                                        ¦    S - Slope           2.4618 ¦
                                        ¦    O - Offset          -0.000 ¦
                                        ¦    E - Elevation         1000 ¦
                                        ¦    R - RightDigits          3 ¦
                                        +-------------------------------+
```

SYSTEM SETUP\CONFIG SENSORS\Average

Average *A - Average*

The *Average* field can have a value of either ON or OFF. Set *Average* ON for any sensor you want to sample and compute an average for. With Average ON, the 8200 will use the *MeasInt* and *SampTim* (in the *MEASUREMENT SCHEDULE*) to control when sampling starts and SampInt to control how often the samples are taken. After *#Samples* have been taken, the average is computed and stored as the current value for the sensor. The slope and offset are applied after the average has been computed to scale the value to its proper units.

Average and *Measure* are mutually exclusive. If you set *Average* ON, the 8200 will automatically turn *Average* OFF and vice versa. The reason they are exclusive is that it would be useless to start sampling and compute an average only to have the value overwritten by the measure performed because of the *Measure* ON.

SYSTEM SETUP\CONFIG SENSORS\Elevation

Elevation *E - Elevation*

Elevation is an offset that gets added to a value before it is displayed. It is for display purposes only and does not alter the data that is logged. It is called *Elevation* as it is commonly used to enable the 8200 to display the actual elevation of a water surface.

Example: Set up the 8200 to display the actual water surface elevation above mean sea level for a sensor installed to read 0 at an elevation of 3200.

Elevation = 3200

The display will now show 3215.52 if the shaft encoder is at a position of 15.52.

You should only need to use the *Elevation* parameter if your sensor offset is larger than the largest number which can be stored in the log, otherwise you should use the *Offset* parameter. For instance if you install a shaft encoder at 1000 feet above sea level and require 0.01 foot resolution, you cannot use an offset of 1000. If set the offset to 1000, the 8200 will have values for the sensor such as 1001.23 which exceeds the maximum value the 8200 can log with 2 right digits (327.67). If you instead set the *Elevation* to 1000, the 8200 will be able to log the measured portion of the value (1.23) and still display the value as 1001.23 because the Elevation is added whenever the value is displayed.

SYSTEM SETUP\CONFIG SENSORS\Intervl

Intrvl *I - Interval*

Interval (*Intrvl*) affects how often data is written to the Log. With *Interval* set to 00:00:00, the 8200 will write data to the log (for those sensors with Log ON) at the end of each measurement cycle (or multiple of cycles if measurements per log is not 1). If *Interval* is set to a time other than 0, the 8200 will wait for the required time before logging the data. For example: with *Interval* set to 01:00:00, data will be logged only on the hour even though the log may be set up to handle data every minute.

With *Interval* set to 99:00:00, the 8200 turns all control of logging over to BASIC for that sensor. BASIC is thereby responsible for any values that get written to the log.

Even though *Interval* allows you to omit data from the log, the size of the log remains the same. The effect of *Interval* is to prevent certain values from being written to the log. These missing values are skipped during a transmission of the data which can greatly reduce the amount of time it takes to transmit a full day's worth of data. Both the self-timed and random transmissions for GOES are also affected as sensors not logged are not transmitted (vs transmitting missing values).

Sutron standard protocol does not take advantage of this option, hence transmissions over LOS Radio or telephone (using SSP) will still include some overhead for missing data. Yet, there is some improvement because missing data requires 1 byte to send, whereas a data value needs 5 bytes.

SYSTEM SETUP\CONFIG SENSORS\Log

Log *L - Log*

The *Log* field can have a value of either ON or OFF. When ON, the 8200 reserves space in its log for the data of that particular sensor. At the end of taking its measurements and computations, the 8200 will check each individual sensor to see which ones have the *Log* function switched on.

If *Log* is OFF, no space is reserved for the sensor and the data cannot be stored in the log.

The amount of space taken up by a sensor in the log is controlled by *MeasInt* and Measurements per Log. With *MeasInt* set to 00:15:00 and Measurement per Log set to 1, the log will be prepared for 15 minute data. If Measurement per Log is set to 2, the log will be prepared for 30 minute data.

Note: Changing the *Log* status for a sensor, the measurement time or the measurements per log will cause the 8200 to resize its log and erase any old information in the log. This will be done when recording is turned ON.

SYSTEM SETUP\CONFIG SENSORS\Measure

Measure *M - Measure*

The *Measure* field can have a value of either ON or OFF. When ON, the 8200 will make a measurement for the sensor and store it as its last value during each measurement cycle. When OFF, the 8200 does not make an automatic measurement but the value can still be measured using the *BASIC MEASURE* statement. (See *MeasInt (page 4-75)* and *MeasTim (page 4-76)* for a description of measurement times).

When a sensor is measured, it is scaled by the slope and offset before being saved as the last value.

SYSTEM SETUP\CONFIG SENSORS\Offset

Offset *O - Offset*

The 8200 uses *Slope* and *Offset* to scale sensor's data when it is measured or sampled. The equation is:

Converted_Value = Raw_Value * *Slope* + *Offset*

See the “How To..” section (Chapter 7-3) for help in computing the slope and offset for a sensor.

SYSTEM SETUP\CONFIG SENSORS\Right Digits

Right Digits *R - RightDigit*

The *Right Digits* field affects to how many digits numerical data is displayed and logged. The 8200 log is a collection of 2-byte (16-bit) integers. One bit is used for the +/- sign, leaving 15 bits for a data value. With *Right Digits* set to 0, a sensor is displayed without a fractional part. The maximum value is 32767. With Right Digits set to 1, the tenths digit is displayed. The maximum value is reduced to 3276.7. In a similar manner for each increase in *Right Digits* the 8200 adjusts how data is displayed, and the maximum

value. The following chart summarizes the effect *Right Digits* has on the maximum value which can be logged:

Right Digits	Data Range Min	Max
0	-32767	32767
1	-3276.7	3276.7
2	-327.67	327.67
3	-32.767	32.767
4	-3.2767	3.2767

Note: Make sure the *Right Digits* setting is correct for your application. A setting that is too large will result in a "clipping" of logged values and a loss of important data.

SYSTEM SETUP\CONFIG SENSORS\Slope

Slope *S - Slope*

The 8200 uses *Slope* and *Offset* to scale a sensor's data when it is measured, sampled, or viewed. The equation is:

Converted_Value = Raw_Value * *Slope* + *Offset*

(The raw value is multiplied by the *Slope* and then the *Offset* is added. Raw values will be in volts, counts, or hertz for the standard analog/pressure, counter, and frequency inputs)

See the “How To..” section (Chapter 7-3) for help in computing the slope and offset for a sensor.

SYSTEM SETUP\CONFIG SENSORS\Value

Value *V - Value*

Value represents the current reading for the sensor with the slope and offset applied.

On the front panel, a new measurement will not be taken unless you press the ▶ right arrow.

If you change *Value* for a sensor which has "#" as the first character in its name (See BASIC), the 8200 will simply store the value you enter as the last value for the sensor. This provides a nice way for you to interact with a BASIC program that is using the values as user input to affect the way the program works.

Changing the *Value* for a counter and encoder sensors, resets the counter hardware to the value you enter. It does not change the slope or offset for the sensor.

Changing the *Value* setting for most other sensors initiates a calibration sequence that can automatically compute and set the slope and offset. This is useful for an analog sensor such as a gate opening that needs to be calibrated on site. Perform the following steps for an auto calibration:

1. Move the sensor input at a known value.
2. Set *Value* to the known reading.
   A new offset will be computed
3. Move the sensor input at a different value
4. Set *Value* to the new known reading.
   A new slope and offset will be computed.

If you only want to adjust an offset press ▶ or select another sensor after step 2. Do not press SET (frontpanel) or V (keyboard) again, or the software will recompute and set invalid numbers for the slope and offset.

Note: if you have enabled TINY-BASIC vectoring for a sensor, turn Recording OFF before setting the value. You cannot calibrate the sensor in the final units because TINY-BASIC is not running. You must calibrate the sensor only in the units available prior to the TINY-BASIC equation.

SYSTEM SETUP\ENABLE SENSOR

ENABLE SENSOR E - Enable Sensors

This Sub-menu displays a list of all the sensors supported by the 8200 and allows each sensor to be enabled (ON), disabled (OFF) or renamed.

Sensors that are enabled can be configured (see the CONFIG SENSOR menu on the next page). A sensor that is disabled (OFF) cannot be configured and will be ignored by the 8200. If you disable a sensor after configuring it, the 8200 will preserve the configuration information but will not apply it since the sensor is disabled. When the sensor is re-enabled, the previous configuration information will be restored.

To enable or disable a sensor from the front panel, use the up/down arrow keys to display the name of the desired sensor and press the SET key (front panel). The value for enable will change from OFF to ON each Time SET is pressed.

If you are using a PC, the 8200 will create a display similar to the one that follows. Note the menu displayed at the top of the screen. To enable or disable a sensor from the keyboard, use the arrow keys to move the ">" pointer to the desired sensor and press [ENTER]. Sensors with "*" in front of the name are enabled and those without the "*" are disabled.

```
+----------------------------[ SELECT SENSORS ]---------------------------
-+
¦ Choose [U]p [D]own [L]eft [R]ight [ENTER] [N]ame [M]ore:
¦
+-------------------------------------------------------------------------
-+
    >  Analog1        Counter2       WindSpeed2     Deviation      DataPack
       Analog2        Counter3       WindSpeed3     Serial         Excitation
       Analog3        Counter4       WindSpeed4     Battery        Ground
     * Analog4        Frequency      WindDir1       Shaft8500      Reference
     * Pressure       Frequency1     WindDir2       Rain           Amplifier
       Encoder1       Frequency2     WindDir3       Org100         Optional
       Encoder2       Frequency3     WindDir4       Org700
       Counter        Frequency4     WaterLevel     Timer1
       Counter1       WindSpeed1     Outliers       Timer2
```

To change the name of a sensor from the front panel, first enter the *ENABLE SENSORS* sub-menu. Then, using the up/down arrow keys to display the sensor that will be renamed, press the ▶ right arrow key. A flashing cursor will appear over the first character. Use the up/down arrows to change each character value and the left/right arrows to move between characters. When finished, press SET to make the change permanent or ON/OFF to cancel the change. Note that a "#" cannot be programmed into the name from the front panel. (For more information on resetting values, see Chapter 3)

To change the name of a sensor from a keyboard, use the arrow keys to move the ">" pointer to the desired sensor and press "N". Then type in the new name for the sensor or use backspace to edit characters in the name. Press [ENTER] to make the change permanent or [ESC] to cancel the change. Note that the default name for the sensor is given at the bottom of the screen for the sensor pointed to by ">".

SYSTEM SETUP\MEASMNT SCHEDULE

MEASMNT SCHEDULE M - Measurement Schedules

Scheduling in the 8200 is controlled by values setup in the *MEASUREMENT SCHEDULE* sub-menu (see below for more detailed information, and an explanation of each of these values).

The order of the parameters in the sub-menu is:

Measurement Interval -	MeasInt
Sample Interval -	SampInt
Measurement Time -	MeasTim
Sample Time -	SampTim
Power Time -	PwrTim
No. of Samples per Set -	#Samples/Set
No. of Measurements per Log -	#Measmnt/Log
Basic Run Interval -	BasInt
Basic Run Time -	BasTim
Switched Power Options -	PwrMode

SYSTEM SETUP\MEASMNT SCHEDULE\#Measmnt/Log

#Measmnt/Log *L - Measurements per Log*

Measurements per log (*#Measmnt/Log*) is the number of processing cycles between times when data is logged (recorded) to the 8200 memory for sensors configured with Log ON (SYSTEM SETUP\CONFIG SENSORS).

Measurements per log should be set to one (1) under almost all circumstances. Setting the *measurements per log* value to 2 will cause data to be logged every other processing cycle. A value of 3 would cause data to be logged every third cycle, and so on. The benefit of this is that it is possible for the 8200 to measure data more frequently than it is logged. This frequently measured data is available for transmission over a radio or satellite even though the 8200 is not logging every value measured.

GOES USERS!
Measurements per log has a direct affect on the data sent in a GOES random transmission. When it is set to one (1) the binary transmission will contain data from the log. If *Measurements per log* is set to a value other than one, the first data record of a random transmission will contain current data (current data is the last data measured), followed by data from the log. This provides the data which may have caused an alarm to be sent in the random transmission.

SYSTEM SETUP\MEASMNT SCHEDULE\#Samples/Set

#Samples/Set *A - Samples to Average*

Samples per set (*#Samples/Set*) controls the number of individual readings which will be collected from each sensor configured with AVERAGE ON prior to computing an average (SYSTEM SETUP\CONFIG SENSORS). The sampling stops when *#Samples/set* number of values have been collected or when the next measurement Time is reached.

SYSTEM SETUP\MEASMNT SCHEDULE\BasInt

BasInt *B - Basic Run Interval*

BasInt sets the interval at which the Tiny-BASIC program is run. A *BasInt* of 00:00:05 would cause the basic program to run once every 5 seconds; BasInt of 00:15:00 would cause the basic program to run once every 15 minutes, and so on. If *BasInt* is set to a shorter amount of Time than the Time it takes to run the program, intervals will be

missed. For example, if *BasInt* is set to 00:00:01 and the basic program needs 2.5 seconds to run, the program will be run every 3 seconds.

If you need the 8200 to perform functions at several Time intervals, you must set *BasInt* to the shortest interval and use instructions in Basic to check for the longer intervals. For example, if you want to sample once every 5 seconds a value and accumulate it for an hour, set BasInt to 00:00:05 and then check in the program for the hour interval. (see Chapter 8 for more details.)

SYSTEM SETUP\MEASMNT SCHEDULE\BasTim

BasTim — *R - Basic Run Time*

Basic Run Time (*BasTim*) sets the Time at which the basic program should be run. The Time can be the same Time as *MeasTim* if the BASIC code makes its own measurements. If the BASIC code does not MEASURE sensors it may use values from sensors with MEASURE ON or AVERAGE ON. In this case, it is necessary to have the *Basic Run Time* several seconds after MeasTim so the new values are available when the basic program runs. (see Chapter 8 for more on Tiny-BASIC.)

Example: The following setup causes the basic program to run once every hour, 30 minutes in to the hour.

BasTim = 00:30:00
BasInt = 01:00:00

SYSTEM SETUP\MEASMNT SCHEDULE\MeasInt

MeasInt — *M - Measurement Interval*

The measurement interval (*MeasInt*) is the Time (HH:MM:SS) that elapses between measurement cycles. During each measurement cycle, the 8200 will take new readings from any sensor enabled with MEASURE ON.

MeasInt is also used to prepare the LOG for data. The LOG will be setup to store data at the specified MeasInt for all sensors with LOG ON.

A typical value for *MeasInt* is 00:15:00 to save 15 minute data from the sensors. Intervals of much longer and shorter duration are also possible.

SYSTEM SETUP\MEASMNT SCHEDULE\MeasTim

MeasTim — *T - Measurement Time*

Measurement Time (*MeasTim*) is the Time (in the format HH:MM:SS) at which the 8200 will begin taking single readings from sensors with the Measure function enabled (SYSTEM SETUP\CONFIG SENSORS). For many applications, *MeasTim* can be left at the default value of 00:00:00. When the 8200 is done taking measurements, the values are written to the log for any sensors that are enabled with LOG ON.

MeasTim should not be looked at as an absolute Time but as a synchronization Time. A *MeasTim* of 00:00:00 causes measurements to be synchronized to the hour. If *MeasInt* is 00:15:00 it would make no difference if *MeasTim* were 00:00:00 or 01:00:00 or 02:00:00 or 00:30:00 because they all define the same set of times (00:00:00, 00:15:00, 00:30:00, ...). If the current time is 12:00pm and the *MeasInt* is 1:00 and the *MeasTim* is 17:30, the 8200 will start measuring at the next valid interval 1:30pm (the 8200 will not wait until 5:30pm).

Example:

MeasTim	= 00:30:00
MeasInt	= 01:00:00

The above values cause the 8200 to Measure once an hour synchronized to the half hour (e.g. 00:30:00, 01:30:00, 02:30:00 ...).

SYSTEM SETUP\MEASMNT SCHEDULE\PwrMode

PwrMode — *O - Switched Power Options*

PwrMode has the following options. The options are selected by toggling through the list using the SET key on the front panel or the O key on the terminal.

OFF	the +12v power remains off at all times.
ON	the +12v power is turned on and left on at all times.
ADVANCE	timing of turn-on and turn-off are tied to PowerTim and MeasTim (pages 4-77, 4-76). Power will be turned on at PowerTim, remain on through all samples and measurements, and be turned off when the last measurement is complete.
MEASURE	the +12v power will be turned on prior to each and every measurement of a sensor and turned off immediately thereafter
ALARM+	the +12v power will normally be turned off. If an alarm condition occurs, the +12v power will be turned on and will remain on until the alarm condition clears.

ALARM-	the +12v power will normally be on. If an alarm condition occurs, the +12v power will be turned off and will remain off till the alarm condition clears
MODEM	the +12v power will be turned on 1 second before the 8200 dials out, and turned off after the 8200 hangs-up on speech/modem equipped units. This option is meant to be used to toggle power to a high-power cellular phone. PwrMode MODEM is functionally the same as PwrMode ALARM+ - this allows switched power to also be turned on at fixed intervals by setting appropriate control alarm levels on Timer1 or Timer2. This would allow a cellular phone to be turned on during certain times during the day to allow dial-in.

A delay Time (called *PowerDelay*) analogous to the *AnalgDelay* and *PressDelay* is provided in the EEROM SETUP sub-menu (see page 4-17).

SYSTEM SETUP\MEASMNT SCHEDULE\PwrTim

PwrTim — *P - Switched Power Time*

If Power Mode in the MEASUREMENT SCHEDULE sub-menu is set to ADVANCE, *Power Time* is the Time that the 8200 will turn on the +12v SW PWR on the terminal block. In all other cases, *PwrTim* is ignored. (see PwrMode, below page 4-76 for a description of all the power modes).

SYSTEM SETUP\MEASMNT SCHEDULE\SampInt

SampInt — *I - Sampling Interval*

The sample interval (*SampInt*) is the Time (HH:MM:SS) which will elapse between sample collections for all sensors configured with AVERAGE ON (SYSTEM SETUP\CONFIG SENSORS). With *SampInt* set to 00:00:01, the 8200 will sample the sensors every second. The sampling continues until the proper number of samples have been collected or the next measurement Time is reached. 00:00:00 is a valid time for the sampling interval which tells the 8200 to take samples as fast as it can.

After setting up the 8200 you should use the INSPECT SYSTEM/Display Status (preferably from a test set since it can update the screen much faster than the front panel) option to monitor the recording status. When the 8200 takes samples, the message "Averaging #1", "Averaging #2", "Averaging #3", etc. will appear. By monitoring this count you can make sure the 8200 takes all the samples you expected and is not missing any because the Sampling Interval is shorter than the time the hardware needs to take all of the samples.

SYSTEM SETUP\MEASMNT SCHEDULE\SampTim

SampTim — *S - Sampling Time*

Sample Time (*SampTim*) is the Time at which the 8200 will begin collecting a set of samples for the purpose of computing an average. Sample Time applies to all sensors with Average enabled (SYSTEM SETUP\CONFIG SENSORS). *SampTim* can be left at the default value of 00:00:00 for many applications.

SampTim should not be treated as an absolute Time but as a synchronization Time. A *SampTim* of 00:00:00 causes the start of sampling to be synchronized to the hour.

Example: The following setup will sample every second for 60 samples to compute an average. The sampling will start at 00:59:00, 00:14:00, 00:29:00 .... The data will be logged at 00:00:00, 00:15:00 ....

SampTim	= 00:59:00	start sampling one minute before the measurement
SampInt	= 00:00:01	sample once a second
#Samples/Set	= 60	take up to 60 samples
MeasTim	= 00:00:00	measure other sensors and log data synchronized to the hour
MeasInt	= 00:15:00	repeat every 15 minutes.

SYSTEM SETUP\Basic Program (PC Only)

-- — *B - Basic Program*

When using the Test Set, this option from the System Setup Menu gives you the ability to work with the BASIC program. When this is selected, the 8200 will display the basic prompt ">". It will then accept any of the Basic commands.

> Note that the 8200 will turn recording OFF when you select this option.

At the ">" prompt, programs can be listed, entered, altered, and run. Statements can be executed immediately to view variables or perform another function. See Chapter 10 for further information.

SYSTEM SETUP\Change Password

Change Password *P - Change Password*

Change Password is used to set an access password for the 8200 setup. Up to 5 letters may be entered to specify the password. When the password is blank it is disabled and the system will not prompt for the password to when you try to use one of the setup menus (SYSTEM SETUP etc.). When the password is not blank, the 8200 will prompt for the password when you first try to use a setup menu. If the password is entered correctly, you will have access to all 8200 setup menus. You will not need to enter the password again until the display is turned off or you log off if using a modem. If you do not enter a correct password, the 8200 display the message "Bad Password" and not allow you access to the setup.

If you forget the password, it can be initialized to blank (disabled) by pressing the down arrow key while powering up the 8200. The message "Password Init" will flash on the screen if the operation is done correctly.

SYSTEM SETUP\Init Setup

Init Setup *I - Init Setup*

Init Setup clears the setup in RAM to a default state. It is commonly used to clear out an old setup all at once rather than changing each item one at a Time.

When using the PC, the 8200 will prompt "Are you sure" when this function is selected. Press Y to proceed with the function or any other key to abort.

Note: *Init Setup* does not affect the EEROM setup values.

SYSTEM SETUP\Zero Counters

Zero Counters *Z - Zero Counters*

Zero counters will initialize Encoder1, Encoder2, Counter, Counter1, Counter2, Counter3, and Counter4 to zero. This should be used before calibrating these sensors.

VIEW DATA

VIEW DATA *V - View Sensor Data*

VIEW DATA is a sub-menu with four fields: LIVE READINGS, NEWEST READINGS, OLDEST READINGS, and Alarm Status. These fields provide a way to view both current and logged sensor data. The menu appears as:

```
View Sensor Data Menu
  L - Live Data
  N - Newest Data
  O - Oldest Data
  A - Alarm Status
Choose:
```

VIEW DATA\ALARM STATUS

Alarm Status *A - Alarm Status*

When using a PC, a display will be generated listing all the sensors with ALARM not OFF, the current reading, the trend and alarm status as shown in the example below. When using the front panel the information will be scrolled across the screen.

```
SENSOR        READING       TREND         ALARMS
=========     =========     ========      ========
AirTemp       44.226        FALLING       LOW
BaroPress     15.605        STEADY
SolarRad      3.462         RISING        HIGH
RainFall      4.940
WindSpeed     5.862                       RATE
WindDir       350.328
Battery       12.500
Press SPACE to repeat or ESC to exit:
```

VIEW DATA\LIVE READINGS

LIVE READINGS *L - Live Data*

Using the front panel, *LIVE READINGS* requires you to press the ▶ right arrow key to enter the list of enabled sensors. If no sensors are enabled, the message "None Enabled" will flash. Once in the sub-menu, use the up and down arrows to select the desired sensor.

Live data will be refreshed at most 10 times a second. The data will have the slope and offset applied (except for DEVIATION, OUTLIERS, TIMER1, TIMER2) and will be displayed using the number of right digits specified in the configuration. The data will

not be averaged even if the sensor has AVERAGE ON. If Recording is ON and TINY-BASIC has set RUNLINE for the sensor (see page 10-20) the TINY-BASIC code will also be applied to the data. For example, if you have set up vectoring on analog1 to convert the voltage to temperature units, VIEW-LIVE readings will display the value for analog 1 in VOLTS if Recording is OFF, or in temperature units if Recording is ON.

You may press the SET key to change the value of a sensor. This will adjust the offset of the sensor to make the live reading match the number you enter. For counter and encoder sensors, it will set the hardware counter and not alter the sensor offset. This is a convenient way to calibrate sensors such as shaft encoders which have a fixed slope, but often suffer from offset drift. If you are using the TINY-BASIC RUNLINE command for additional conversions on the sensor, you cannot calibrate the sensor in the final units. You may only calibrate the sensor to the point before TINY-BASIC applies its equation. To do this, turn Recording OFF before setting the value. This will change the offset for the sensor. Then turn Recording ON and see the effect of the new offset on the final TINY-BASIC computed value.

Taking *LIVE READINGS* will not normally interfere with scheduled measurements, sampling, and transmissions. The exception is when a sample may be missed when the time to measure a sensor is very near the measurement and logging time at which the sensor is being recorded. For example if you have an SDI-12 sensor which requires 45 seconds to measure and you want to log it every 60 seconds; there will not be enough time to take one live reading and one logged reading every minute, and samples will be missed.

Using a test set, *LIVE READINGS* will display a complete list of enabled sensors along with a menu at the top of the screen. Use the arrow keys and the [ENTER] key to select sensors. An "*" will be placed in front of sensors that are selected. Then press V to view the data and enter the time delay between updates (use 10 to cause the display to pause one second between updates). The 8200 will then display the selected sensors along with live data updated as selected. To exit the live display, press [ESC].

Note: Live readings can be viewed whether or not Recording is ON. However, if Recording is OFF, the 8200 may not have turned on the switched power needed by a sensor.

When using a PC, the following menu appears when L-Live Data is selected:

```
+----------------------------[ LIVE READINGS ]----------------------------
-+
¦ Choose [U]p [D]own [L]eft [R]ight [ENTER] [M]ore [V]iew [S]croll:
¦
+-------------------------------------------------------------------------
-+
    >  Analog4        Pressure
```

The display lists all enabled sensors (Analog4 and Pressure in the example) and a menu of available commands ([U]p, [D]own and so forth). Use the U, D, L, R or the arrow keys to move the cursor (>) to point to each sensor you want displayed and press [ENTER]. The display will show a * in front of any sensor that will be displayed. Once you have selected the sensors, press V to view the data. The software will prompt for a time delay and then display live readings for the selected sensors. Press [ESC] to end the display. The SDI-12 port shares the same serial port as the test set - so when the 8200 is reading an SDI-12 sensor it is not paying any attention to the test set. You may need to

hold down (or press repetitively) the [ESC] key to exit live readings when measuring these sensors.

VIEW DATA\NEWEST READINGS

NEWEST READINGS N - Newest Data

NEWEST READINGS can be used to take you into the log positioned at the most recent data. To do so, press the ▶ right arrow key to display the enabled sensor list. Use the ▲ up and ▼ down arrow keys to select the sensor of interest and press the ▶ right arrow key to view the data.

The data is displayed in the format: ddd hh:mm value where ddd is the Julian day for the data. If you wish to know the calendar day for any entry, simply press the ▶ right arrow key and the calendar date will be displayed briefly.

Once in the log, the ▲ up and ▼ down arrows can be used to view data in both directions. Pressing a key will go to the adjacent value. You may skip through the log in increments of one day by holding either the ▲ up or ▼ down arrows and then pressing or holding down the ▶ right arrow. You may skip through the log in increments of one hour by holding either the ▲ up or ▼ down arrows and then pressing or holding down the ◀ left arrow. Using these methods the entire log may be spanned in less than two minutes.

While in the log, SET can be used to alter one of the values. Remember, the ON/OFF key can be used to cancel the data entry if it is done before SET is pressed to finalize it.

When using a PC, the following menu and data appear when N-Newest Data is selected. The data will be the most recent data from the LOG. Note that the menu lists the keys that can be pressed to move to the top (beginning of the log), bottom (end of the log), up (back in time), down (forward in time) and so forth. [S]earch can be used to position to any day in the log, and [M]odify is used to change or erase readings on the screen.

```
+------------------------------[ LOG DATA ]------------------------------
-+
¦ Choose [T]op [B]ottom [U]p [D]own [L]eft [R]ight [S]earch [M]odify:       ¦
+-------------------------------------------------------------------------
-+
                     AirTemp    BaroPress SolarRad  RainFall  WindSpeed
09/24/1992 03:45:00  41.96      16.00     -0.03     4.94      3.8
      04:00:00       41.84      15.64     0.00      4.94      3.5
      04:15:00       41.53      15.79     -0.03     4.94      3.7
      04:30:00       41.53      15.45     0.02      4.94      4.1
      04:45:00       41.33      15.64     0.05      4.94      3.6
      05:00:00       41.27      15.58     0.05      4.94      3.8
      05:15:00       41.09      15.67     0.34      4.94      4.0
      05:30:00       41.57      15.60     0.88      4.94      4.0
      05:45:00       42.35      15.67     1.74      4.94      4.3
      06:00:00       43.10      15.63     2.57      4.94      4.9
      06:15:00       44.22      15.60     3.46      4.94      5.8
      06:30:00       ---.--     ---.--    ---.--    ---.--    ----.-
      06:45:00       ---.--     ---.--    ---.--    ---.--    ----.-
      07:00:00       ---.--     ---.--    ---.--    ---.--    ----.-
      07:15:00       ---.--     ---.--    ---.--    ---.--    ----.-
      07:30:00       ---.--     ---.--    ---.--    ---.--    ----.-
      07:45:00       ---.--     ---.--    ---.--    ---.--    ----.-
      08:00:00       ---.--     ---.--    ---.--    ---.--    ----.-
      08:15:00       ---.--     ---.--    ---.--    ---.--    ----.-
      08:30:00       ---.--     ---.--    ---.--    ---.--    ----.-
```

VIEW DATA\OLDEST READINGS

OLDEST READINGS *O - Oldest Data*

OLDEST READINGS can be used to take you into the log at a point of the oldest data entry. The date of this data depends on the size of the log. To go to the oldest readings, press the ▶ right arrow key to display a list of enabled sensors. Use the ▲ up and ▼ down arrow keys to select the sensor of interest and press the ▶ right arrow key.

Once in the log, the display operates as explained under the NEWEST READINGS heading.

Chapter 5

Quick Setup

This chapter focuses on the setup sheet and gives hints on filling it out as well as entering the information into the 8200.

Review

In the first three chapters of this manual, you learned how to power up an 8200 and use the front panel and PC menus. You were also introduced to the reference chapter of all the 8200 menu items. In the remaining chapters of this manual, you will learn more about its many applications in actual field operations. Covered in these chapters will be topics such as hooking up sensors; the different field setups you may need to configure the 8200 for; using the Tiny Basic programming language to maximize your control over the 8200 operation: and other relevant information.

If you are a new user, please work through Chapter 3 before continuing through the rest of this manual. Once you have mastered the concepts in Chapter 3, you will be prepared for the information that follows.

Basic 8200 Setup

Remember that the Setup Sheet is the tool used to specify the details of the 8200 setup. You should create a setup sheet for each site and use it when setting up a site. Do not trust your memory for this important information. Blank setup sheets are found in Appendix B.

We will now take you through the steps of filling out the Setup Sheet. Use the reference Chapter 4 to get complete details on any of the fields.

1. UNIT ID and Location Information -- Pick a name or number for the Unit ID. If you are using a telephone speech unit, make it a number so that the ID will be recognizable when it is spoken. The 8200 will also use the ID when communicating using Sutron Standard Protocol. The Setup Sheet has space for also recording the location and the name of the person who filled out the setup sheet. These last two values are for informational purposes only and are not entered into the 8200.

2. 8200 Sensor Type -- Use table 2 provided on page 6-6 and decide what sensor names you will be using. Make sure you do not pick two sensor names that use the same connection unless you want the same value measured twice. Enable must be ON for any of the sensors you will use. If you want to rename the sensor, write the new name in the appropriate column.

3. Sensor Configuration -- Decide whether the sensor is to be measured or averaged. If Measure is ON a single value will be collected. If Average is ON, more than one value is collected and then the average is computed. Set Log ON if you want the 8200 to make room in the LOG for the value. Intrvl will be set to 00:00:00 for most common sensors instructing the 8200 to LOG the data at the end of each measurement cycle. If you set Intrvl to a different value, make sure you understand what you are doing. Intrvl = 99:00:00 disables automatic logging and leaves it to TINY-BASIC.

If you leave the slope at 1.0, the 8200 will report the measurement in its basic units of volts, hertz or counts. If you set the Slope to 0.0 as this will result in logging the offset as the value. You can use the guidelines given in Chapter 7, page 7-3 to come up with some

different values for the slope and offset or use the auto calibrate feature built into the Value field.

Right digits controls the range of data that is logged. Be sure your sensor value will not exceed the range called for by Right digits.

4. Measurement Schedule -- The measurement interval is the basic data collection and logging interval. If you want to collect and log data every 15 minutes, set measurement interval to 00:15:00. If you have no averaging planned you can leave the sampling interval, measurement time, sampling time all at 0. Set a time for Switched Power if you need to turn on a sensor for a few seconds before taking a measurement. If the power is to be on all the time or off all the time, leave it at 0 and set the Switched Power Option to ON or OFF.

5. EEROM Setup -- You can use the default values for most all the EEROM fields. Don't bother filling in the blanks when you are using the defaults. One field you may want to change is the TimeLimit. With TimeLimit at 60, the 8200 will turn off the display after 60 seconds of inactivity. If you are using a sensor connected to the PRESSURE port, make sure you get the AmpGain for the 8200. 8200A models to not need the AmpGain, but 8200s do in order to make accurate measurements on the pressure port. Since you may not know which 8200 you will be using, make a note to use the AmpGain recorded on the shipping documents you received.

6. PROTOCOL Setup -- These fields are used when the 8200 needs to communicate using Sutron Standard Protocol (SSP). The default values will work well in most all stations. Change a value only after you have a thorough understanding of the field and run extensive tests to verify the 8200 operations after the change.

7. At this point if you have the basic setup for an 8200. An 8200 with this setup can have Recording turned ON and will begin to collect and log the data you desire. If you have a telephone or GOES unit then some additional steps are required before the 8200 will work with the phone or transmit the data. For these models, consult the following sections for your appropriate model.

Telephone With Speech/Modem

1. Alarm Setup -- You should set the Enable for each of the sensors to ON for all the sensors. Even if you don't have any alarms, this setting will make each sensor show up in the Alarm Status list and allows you to set the Prefix and Suffix numbers. With ENABLE set to something other than OFF, the data for the sensor will also be included in the reply to a SSP poll for current data. If you want the 8200 to actually dial up someone or something on alarm, set Enable to DIAL. You should pick word or phrase numbers for the Prefix and Suffix so the 8200 has a way of identifying your data. Refer to the table on page 4-43.

2. Modem Setup -- The most common setting for Answer Mode is Voice and Data. In this mode, the 8200 will answer "Please press pound" and pause for a few seconds. If "#" is not pressed, the 8200 will turn on its modem signal and try to establish a data link. The other Answer Modes are available if you need them.

With The Answer Mode in one of the voice modes, you will want to pick a Dial-In message. A common one is IdLivMen which causes the 8200 to speak the ID, speak live (current) data and then give you a menu. Other "canned" dial-in messages are available. You can also construct your own dial-in messages from the functions and words listed on page 4-43. Be careful when building your own message as it is easy to write down a single wrong character that will throw the whole message off. Remember, custom messages can be entered only using a PC. If the person installing the 8200 does not have a PC, use one of the canned messages. Do the same for Dial-Out message.

Pick a password for the station to protect your unit from unauthorized users. You can probably use the same password for all your sites. If you want to dial-out on alarms, set Dial-Out Enable ON and specify the phone numbers as needed.

3. EEROM Setup -- Set Enter Reqd to ON. The 8200 will expect an [ENTER] to be pressed after a menu item. When working over phone lines, this helps lessen the chance that noise will cause menu to be selected.

LOS Radio

1. Alarm Setup -- Set ENABLE to ON for each sensor you want included in a poll for current data. If the sensor ENABLE is set to OFF, the data will not be reported. If you want to have alarm transmissions, you must define the type of alarm by setting High Alarm, Low Alarm or ROC Alarm to the appropriate value and entering a value in the High Level, Low Level or ROC Level.

2. Protocol Setup -- Set the Master ID to the name of the base station (as set in the base station software). Set TN Rate if you want the 8200 to make transmissions on a periodic basis even when there are no alarms. Set TA Rate to define how often transmissions are made when there is an alarm. Also set RetryIn and #Retries to define how the alarm is repeated. Refer to Appendix F for information on how to use some of the advanced features of SSP.

Satellite Units-Self Timed

1. Alarm Setup -- You should set the Enable for each of the sensors to ON for all the sensors. Then set the GROUPS fields to 0100. This will make it so that all sensors will be transmitted in the self-timed group.

2. GOES Setup -- Select the FormatST as SHEF for ASCII messages or BINARY for binary messages. SHEF format messages are longer but more readable. If you have a computer doing the decoding of the GOES messages you should probably stick with the BINARY format. Leave Internatl OFF for US domestic satellites. Select Carrier ST to short. This will cut the transmission time by 4 seconds

Specify the satellite id, and Channel ST and Time ST this is the GMT transmit time assigned by NESDIS. Add 10 seconds to the time to allow for clock drift (e.g. 02:00:10, not 02:00:00). Specify the Rate ST which is usually 04:00:00 four hour intervals between transmissions

Specify the #Data/TX ST the total number of items from the 8200 log which will be encoded and sent in a single transmission for any and every sensor which has been enabled for self timed transmission.

For example, if you are collecting data every 15 minutes and you want data only for the 4 hour period which has just elapsed then you will calculate #Data/TX ST to be 16 (4 logged values/hour * 4 hours = 16). The total number of values sent in the transmission will be dependent on the number of enabled sensors. For example if you had three sensors enabled, a transmission would contain 3 * #Data/TX ST or 3*16 = 48 values. For 4 hours of redundant data (8 hours total) you would double #Data/TX ST. That is, set it to 32.

Set the DatTim ST to 00:00:00.

Set DatInST to the measurement interval in most cases 00:15:00 (15 minutes). NEVER set this to zero!

Satellite Units Random Reporting

1. Alarm Setup -- You should set the Enable for each of the sensors to ON for all the sensors. Decide which sensor(s) will trigger a random transmission; set Enable to GOES for these sensors. Decide which sensors will be sent along with the sensor that triggers the alarm. Then define the GROUPS field for each sensor. Leave a 1 in the second position of GROUPS if you want to keep the self timed group.

You must also define the specify the type of alarm by setting High Alarm, Low Alarm or ROC Alarm to the appropriate value and entering a value in the High Level, Low Level or ROC Level.

2. GOES Setup -- Random transmissions are already in the binary format with the short carrier so there are no fields to set these values for the random channel. You will need to set Satellite ID as assigned by NESDIS and the Transmit Mode to RANDOM (or BOTH).

3. GOES RANDOM Setup -- The channel used for the random transmission is set in the Random Setup Menu along with fields that determine how often transmissions are made when the 8200 is in and out of alarm. The fields also control what data is pulled from the log for the transmission. Refer to the reference Chapter 4 and also to examples in Chapter 7 for more information on these fields.

Entering The Setup

With the Setup Sheet in hand, it is a simple matter to enter it into the 8200. As already described, you can use the front panel keys or a PC to enter the setup. You should note that the 8200 is capable of working as a Logger after just the basic setup information described above has been entered. The modem or radio specific information simply activates and controls the different communications options.

The following steps should be followed to enter a setup:

1. Use \SYSTEM SETUP\Init Setup to clear out any old setup and initialize the values to default values.

2. Enter the Unit ID from the Setup Sheet

3. Set the Date and Time. Use an exact time reference if using a GOES model and set the time to GMT.

4. Go to SYSTEM SETUP\MEASMNT SCHEDULE. Enter your selections from the setup sheet. Note that many of the values will already be 0 so it will not be necessary to enter them again.

5. Go to SYSTEM SETUP\ENABLE. Enable the sensors as shown on the sheet. Change the names for any sensors that have a new name shown on the sheet.

6. Go to SYSTEM SETUP\CONFIG. Enter the configuration data from the sheet one sensor at a time. Note that you can enter the data only on sensors that have been enabled.

7. Go to SYSTEM SETUP\ALARM. Enter the alarm data from the sheet one sensor at a time. Note that you can enter the data only on sensors that have been enabled.

8. Go to the EEROM menu and enter any values that are noted on the sheet.

9. Go to the PROTOCOL menu and enter any values that are noted on the sheet.

10. Go to the Modem setup or GOES setup and GOES random setup and enter the values.

The setup is now complete. However, recording is OFF because you have been making changes to the setup. Be sure to turn recording ON to start the 8200 operating automatically to collect data.

Recording: OFF/ON

When you are entering the setup, the 8200 keeps Recording OFF. This keeps the 8200 from being confused as you are enabling sensors, setting schedules and so forth. With recording OFF, the 8200 will still answer the phone as setup in the Modem setup and will also communicate over a radio. You can also view live data for some sensors while recording is OFF. However, the 8200 may not have turned on the switched power that one of the sensors needs and you may get erroneous readings.

When you set Recording ON the 8200 gets to work. It will begin to use the schedule information you entered to measure, sample and log data. The 8200 will check for alarms if enabled and perform alarm actions that have been programmed. If the unit has a GOES radio it will use the setup information to make any scheduled and random transmissions specified.

See the Recording section in Chapter 4 for a complete description of Recording ON.

Chapter 6

Hooking Up Sensors

This chapter describes how to hook up sensors to the 8200. It discusses the different kind of sensors that the 8200 can measure (analog, frequency, counter, quadrature, SDI-12 and RS232) and provides details needed to connect and operate them with the 8200.

Concepts

Hooking up sensors is as simple as connecting the wires from the sensor to the terminal strip. As a standard practice you should test each new application (sensor connections and setup) on the bench prior to installing it in the field. Then, create a complete setup sheet (photocopy the one supplied to you in chapter 3 of this manual) and wiring diagram that shows where each sensor wires gets attached to the 8200. This will take the guesswork out of connecting the sensors in the field.

The external input/output capability of the 8200A and 8210 includes:

- Up to Five switch closures (counters)
- Up to Five Frequency inputs
- Up to Two Shaft Encoder inputs
- Up to 8, 0 to +5v analog inputs
- One -5 to 100mv differential input (requires 2 or 4 analog inputs)
- One RS-232 serial port
- One SDI-12 serial port
- One switched +12VDC voltage
- ±5V reference/excitation voltages

The output capability of the 8210 adds:

- switched +5v reference voltage
- Software-controlled switched +12VDC voltage
- Five digital outputs (open-collector) 0 to 5V

The 8210 has an internal OPTO-22 compatible connector for:

- 8 digital outputs 0 to 5V (5 are shared with terminal strip)
- 12 digital inputs 0 to 5V

In addition to the external input capability, the 8200 can monitor and log several of its own internal functions including:

- +5v instrument excitation voltage
- Analog Ground voltage
- +5v A/D reference voltage
- Pressure amplifier voltage (used with the -5 to 100mv differential input)
- Main Battery Voltage
- RAM Card Battery Voltage

Analog Sensors

Analog sensors are sensors with a voltage output. This voltage can be the result from:

- a reference voltage passing through a resistive device
- a powered sensor that has a voltage or current output
- a self-powered sensor a voltage or current output

Examples of resistive sensors are potentiometers that are found in many wind direction, gate opening, position sensors. Other resistive sensors compatible with the 8200 are thermistors and thermilinear sensors (for temperature) and some pressure sensors. Sutron uses a +5V reference voltage for these resistive devices and reads the voltage on a 0-5 volt scale with a 12 bit converter. The accuracy of the measurement is 5.0/4095 = xx millivolts. The sensor should have a resistance of at least 500 ohms and have enough change in resistance to show significant changes in the resulting output voltage.

Pressure sensors or strain gauge sensors have a special port on the 8200. These sensors are powered off +5 and -5 and have an output of less than 100 mv. The 8200 has a special port for measuring these sensors because of the low output. The accuracy of measurements made on this channel is 0.05 mv.

Powered sensors normally have circuits that run off +12V and have an voltage or current output. Examples of these sensors are some humidity, temperature, water quality, flow meters and pressure sensors. These sensors will use the +12 from the 8200 (switched or directly from the battery). If the sensor has a current output, such as a 4 to 20 ma sensor, the output needs to pass through a resistor so a voltage can be measured. An important limitation of powered sensors is that the ground line of the output needs to be common with the power ground.

Self powered sensors have a battery or require no power to operate. The most common example of a self-powered sensor is a pyranometer. Self powered sensors can operate with the 8200 as long as the sensor ground can be connected to the 8200 ground (battery ground). The pyranometer would connect to the pressure port because of its very low output voltage range (0 to 10 mv). Other self-powered sensors will probably connect to one of the 0-5 volt analog channels.

Analog Sensors 5-8

The 8200s have jumpers that set the use of Analog Sensors 5, 6, 7, and 8. When you set one of the jumpers to activate this sensor, you will at the same time disable one of the lines used by the pressure measurement. The following table shows how the jumpers affect the front panel terminations for pressure.

Function	8210 Termination	8200A Termination	8210 Jumper	8200A Jumper
-5V	Analog Press 5	Pressure 1	-5 volt excitation 8210, J19, -5VDIFF	J11,1-2
-Diff	Analog Press 6	Pressure 2	-signal 8210, J14, -DIFFIN	J13,1-2
+Diff	Analog Press 7	Pressure 3	+signal range -5 to 100 mv 8210, J15, +DIFFIN	J14,1-2
+5V	Analog Press 8	Pressure 4	+5 volt excitation 8210, J20, +5VDIFF	J12,1-2
A5	Analog Press 5	Pressure 1	0 to 5 volt 8210, J19, A5	J11,2-3
A6	Analog Press 6	Pressure 2	0 to 5 volt 8210, J14, A6	J13,2-3
A7	Analog Press 7	Pressure 3	0 to 5 volt 8210, J15, A7	J14,2-3
A8	Analog Press 8	Pressure 4	0 to 5 volt 8210, J20, A8	J12,2-3

The jumpers come set at the factory in the position which uses all terminations for the analog inputs. If you want to use a pressure sensor at the site you may need to change the jumper settings. If you still need to make a millivolt measurement but do not need the +5V and -5V reference voltages, you can use Analog Press 5 and 8 for analog measurements and leave Analog Press 6 and 7 for the millivolt input. An example of this type of sensor would be a pyranometer that has a millivolt output but does not use the reference voltages.

Counter/Frequency Sensors

The 8200 counter circuits can be programmed to be either event counters totalizing the counts that are received or frequency counters. In either case, the 8200 expects to see a 0 to 5 volt signal from the sensor. Sensors compatible with the 8200 counter/frequency circuits are tipping buckets, wind sensors with amplified speed output. Tipping buckets have a simple switch inside that closes momentarily when the collector is emptied. This works with the 8200 because the counter/frequency inputs have a pull-up resistor. When the switch closes the circuit is pulled to ground which causes the swing from 5 volts to 0 and back to 5.

When used as counters, the circuits count up to 32767 and then roll over to 0. A clear counter command will also cause the accumulator to reset to 0.

When used to make frequency measurements, the 8200 counts the number of pulses it sees in a one second period to determine the frequency. Because it uses a one second interval, the accuracy is 1 Hz. If you need higher resolution, you will need to make the measurement as a counter and then divide by the interval.

Shaft Encoder (Quadrature) Sensors

Sutron manufactures a shaft encoder with a quadrature output. There are also many other manufacturers of quadrature output sensors. A quadrature sensor is one that uses two signal wires to code 4 states. A quadrature sensor connects to the same terminals that can be used for counter and frequency measurements. When you select a quadrature sensor, the 8200 reprograms its input circuitry to handle the input as a quadrature rather than a frequency. When selected for an encoder, you cannot use the same terminals for frequency/counter inputs.

Quadrature sensors generally require 4 wires: +12 to sensor, GND, signal 1, signal 2.

SDI sensors

SDI 12 is an interface standard for sensors. The intent of the SDI standard is to minimize the difficulty of interfacing the different types of equipment available from different manufacturers, to various data recorder manufacturers products. SDI allows you to connect up to 10 sensors with as many as many as 9 parameters each. The interface is implemented using three wires: ground, +12V and a bi directional data line. Examples of SDI sensors are shaft encoders, pressure sensors, water quality monitors, and analog expansion modules. The list of SDI 12 sensors is growing all the time.

SDI sensors connect to the 8210 using the SDI-23 terminations G (Ground), + (12VDC) and D (Data). On the 8200A the SDI connects to the DB9 connector. The pinouts are:

1. Data
7. Ground
9. +12v

The 8210 protects the +12V line with a thermal, self resetting fuse. For the 8200A, we recommend you put a fuse in the line of the +12V to keep you from blowing the internal fuse if there is a short in the +12V line.

You do need to be careful how you schedule the SDI sensors to be read. Many SDI sensors take a second or two to read; however, there are SDI sensors can take up to 180 seconds to read. Keep in mind the performance of the sensor you are connecting to make sure you do not set the 8200 to measure it more frequently than it can. If you do select a schedule that is too fast for the sensor, you could end up with data missing in the Log.

RS232 sensors

RS232 sensors are those that use the RS232 interfaces. The sensor connects to the DB9 used for the PC test set, external radio and so forth. For this reason, it is not possible to have the 8200 work with an RS232 sensor at the same time as one of these external devices. The EEROM\Serial=SENSOR sets the port to work with a sensor. When set in this mode you will not be able to connect and use a test set. The baud rate for the sensor can be set through the EEROM\User Rate.

When the 8200 measures an RS232 sensor, it asserts DTR which can be used to wake up the sensor. The sensor must then send the data in ASCII as a floating point number followed by a carriage return. Alternatively, the sensor can assert request to send to wake up the 8200 and then send data in ASCII followed by a carriage return.

The sensor can have 0-5 volt signals rather than the RS232 levels; however, it must use the same data sense as RS232.

Choosing Sensors and Making Connections

Each 8200 input connection is associated with 1 or more pre-named sensors. The following list gives all the standard names and the corresponding connections. For example, the sensor named ANALOG1 refers to the analog input connected to A1+ and Encoder1 refers to the sensor connected to ENC1-1 and ENC1-2. Note that several sensors use the same connection such as Analog1 and ORG100. Both sensors can be enabled for the same connection as long as one of the sensors is not Encoder1 or Encoder2. These sensors cause the 8200 to reprogram the connections for quadrature detection making it impossible to make frequency or counter measurements.

The sensor names listed are the default names and can be changed through a command. In chapter 3 (page 3-8) we learned how to change values such as the Unit ID, the Date and the Time. For our example Analog1 can be renamed TEMP to identify it as a

temperature measurement . To do so, enter the Analog1 field in the ENABLE SENSORS sub-menu (Menu Path=SYSTEM SETUP\ENABLE SENSORS\Analog1). Press the ▶ right arrow to bring up the flashing cursor over the first letter A. As in setting the Unit ID, press the up or down arrow to scroll through the alphanumeric list until the desired letter or number is showing. Pressing the ▶ right arrow locks this value and moves you to the next item.

The following table is a comprehensive list of all of the available sensor inputs of the 8200. The Value heading listed in the chart gives the units for the measurement when slope is 1 and offset is 0. The slope and offset must be changed for the value to read in other units (such as degrees, or feet).

Sensor Name	8210 Connection	8200A Connection	Value	Signal
Analog1	A1+	A1+	Volts	0 to 5 volt
Analog2	A2+	A2+	Volts	0 to 5 volt
Analog3	A3+	A3+	Volts	0 to 5 volt
Analog4	A4+	A4+	Volts	0 to 5 volt
Analog5	Analog/pres 5	Pressure1	Volts	0 to 5 volt (8200A with J11, 2-3) (8210, J19, A5)
Analog6	Analog/pres 6	Pressure2	Volts	0 to 5 volt (8200A with J13, 2-3) (8210, J14, A6)
Analog7	Analog/pres 7	Pressure3	Volts	0 to 5 volt (8200A with J14, 2-3) (8210, J15, A7)
Analog8	Analog/pres 8	Pressure4	Volts	0 to 5 volt (8200A with J12, 2-3) (8210, J20, A8)
Pressure	Analog/pres 5	Pressure1	Volts	-5 volt excitation (8200A with J11, 1-2) (8210, J19, -5VDIFF)
	Analog/pres 6	Pressure2		-signal (8200A with J13, 1-2) (8210, J14, -DIFFIN)
	Analog/pres 7	Pressure3		+signal range -5 to 100 mv (8200A with J14, 1-2) (8210, J15, +DIFFIN)
	Analog/pres 8	Pressure4		+5 volt excitation (8200A with J12, 1-2) (8210, J20, +5VDIFF)
	AUX A	Pressure5		+5 volt feedback (used only if internal jumper is on)
Encoder1	ENC1-1	ENC1-1	Counts	Quadrature Input1
	ENC1-2	ENC1-2		Quadrature Input2
Encoder2	ENC2-1	ENC2-1	Counts	Quadrature Input1
	ENC2-2	ENC2-2		Quadrature Input2
Counter	CNT	CNT	Counts	Switch closure or 0-5 volt pulse
Counter1	ENC1-1	ENC1-1	Counts	Switch closure or 0-5 volt pulse
Counter2	ENC1-2	ENC1-2	Counts	Switch closure or 0-5 volt pulse
Counter3	ENC2-1	ENC2-1	Counts	Switch closure or 0-5 volt pulse
Counter4	ENC2-2	ENC2-2	Counts	Switch closure or 0-5 volt pulse
Frequency	CNT	CNT	Hz	Switch closure or 0-5 volt pulse
Frequency1	ENC1-1	ENC1-1	Hz	Switch closure or 0-5 volt pulse
Frequency2	ENC1-2	ENC1-2	Hz	Switch closure or 0-5 volt pulse
Frequency3	ENC2-1	ENC2-1	Hz	Switch closure or 0-5 volt pulse
Frequency4	ENC2-2	ENC2-2	Hz	Switch closure or 0-5 volt pulse
WindSpeed1	ENC1-1	ENC1-1	Hz	Switch closure or 0-5 volt pulse
WindSpeed2	ENC1-2	ENC1-2	Hz	Switch closure or 0-5 volt pulse
WindSpeed3	ENC2-1	ENC2-1	Hz	Switch closure or 0-5 volt pulse
WindSpeed4	ENC2-2	ENC2-2	Hz	Switch closure or 0-5 volt pulse
WindDir1	A1+	A1+	Volts	0 to 5 volt
WindDir2	A2+	A2+	Volts	0 to 5 volt
WindDir3	A3+	A3+	Volts	0 to 5 volt
WindDir4	A4+	A4+	Volts	0 to 5 volt
WaterLevel	Analog/pres 5	Pressure1		-5 volt excitation (8200A with J11, 1-2) (8210, J19, -5VDIFF)
	Analog/pres 6	Pressure2		-signal (8200A with J13, 1-2) (8210, J14, -DIFFIN)
	Analog/pres 7	Pressure3		+signal range -5 to 100 mv (8200A with J14, 1-2) (8210, J15, +DIFFIN)
	Analog/pres 8	Pressure4	Volts	+5 volt excitation (8200A with J12, 1-2) (8210, J20, +5VDIFF)
	AUX A	Pressure5		+5 volt feedback (used only if internal jumper is on)

Sensor Name	8210 Connection	8200A Connection	Value	Signal
Outliers	--	--	Count	available when WaterLevel is Enabled
Deviation	--	--	Volts	available when WaterLevel is Enabled
Serial	RS232	RS232		EEROM must be setup for Serial: SENSOR. The format of the data is xxxx
Battery	--	--		Internal measure of the battery
Shaft8500	RS232	RS232		EEROM must be setup for Serial: SENSOR. The format of the data is xxxx
Rain	CNT	CNT	Counts	Switch closure or 0-5 volt pulse
Org100	A1+	A1+	mm/hr	0 to 5 volt
Org700	A1+	A1+	mm/hr	0 to 5 volt
Timer1	--	--	Counts	count in seconds
Timer2	--	--	Counts	count in seconds
DataPack	Data Cartridge	Data Cartridge	Volts	Measures the +3 bolt battery in the data cartridge **(8200 only)**
Excitation	--	--	Volts	Internal connection of the +5V excitation voltage
Ground	--	--	Volts	Internal connection of the Analog Ground
Reference	--	--	Volts	Internal connection of the A/D +5V reference
Amplifier	--	--	Volts	Pressure Amplifier voltage
Optional	--	--		future use
GoesClock	--	--	Counts	count in seconds from the GOES 1Hz oscillator since power up. Roll over at 32767.
OUT1..8	OUT1..5 , OUT6..8 on internal OPTO-22 connector.	not available	0 = OFF, 1 = ON	The 5 outputs on the terminal strip are current sinking - ON is 0V, OFF is pulled high to 5V. The 8 outputs on the OPTO-22 connector are CMOS compatible - ON is 5V, OFF is 0V.
INP1..12	internal OPTO-22 connector.	not available	0 = OFF, 1 = ON	The 12 inputs on the OPTO-22 connector are CMOS compatible - ON is 5V, OFF is 0V.
SDI0_1..9	SDI-12	SDI-12		9 different readings from SDI address 0
SDI1_1..9	SDI-12	SDI-12		9 different readings from SDI address 1
SDI2_1..9	SDI-12	SDI-12		9 different readings from SDI address 2
SDI3_1..9	SDI-12	SDI-12		9 different readings from SDI address 3
SDI4_1..9	SDI-12	SDI-12		9 different readings from SDI address 4
SDI5_1..9	SDI-12	SDI-12		9 different readings from SDI address 5
SDI6_1..9	SDI-12	SDI-12		9 different readings from SDI address 6
SDI7_1..9	SDI-12	SDI-12		9 different readings from SDI address 7
SDI8_1..9	SDI-12	SDI-12		9 different readings from SDI address 8
SDI9_1..9	SDI-12	SDI-12		9 different readings from SDI address 9

Note: WindSpeed and WindDir are combined to create a vectored reading which when averaged and logged will be a wind vectored average for speed and direction. WindDir must be converted to read from 0 to 360 degrees. Also, WaterLevel readings are made from the pressure sensor, which when averaged performs the data quality assurance program (DQAP). The DQAP method takes a sample set (defined by #Samples/Set) then computes a mean and standard deviations. All readings which are more than 3 standard deviations outside of the mean are removed. Each reading which is removed is called an outlier. The standard deviation is recomputed after the outliers have been removed.

Jumpers set the use of the connections for Analog sensors 5, 6, 7 and 8. Refer to the beginning of this chapter to see how to set these jumpers.

SDI-12 sensors can be renamed to allow any SDI-12 address or measurement number to be specified. This allows the 8200 to support devices which have addresses beyond the basic 10, or require alternate measurement commands.

To remap an SDI-12 sensor from its default name, address and parameter number you can use the form: SENSOR7a_p where SENSOR7 is the name you wish to give the sensor

(up to 7 characters), a is the address of the sensor "0" through "~", and p is the parameter number "1" through "9".

Example: airtempA_1 would read parameter 1 from the SDI-12 device at address "A".

If you wish to use a measurement command other than the default aM!, then you can use the form: SENS5a_pMm where SENS5 is the name you wish to give the sensor (up to 5 characters), a is the address of the sensor "0" through "~", p is the parameter number "1" through "9", and m is the measurement command to use.

Example: stage0_1M3 would use measurement command 3 to read parameter 1 from the SDI-12 device at address 0.

Another feature is that you can define multiple sensors for the same SDI-12 parameter which will allow you to define separate slopes, offsets, and other processing for the same parameter.

Note: this renaming can only be done from a PC. If you try to change the name using the front panel, the underscore _ will be changed to a blank. With the _ missing, the software will not extract the pMm portion of the name or use it to control the measurement.

Grounds

The 8210 has three different grounds on the protection/termination board: analog, digital and chassis.

The analog grounds are A1 AG, A2 AG, A3 AG, and A4 AG. The analog grounds are tied together on the protection/termination board and then the signal takes a separate path to the A/D converter where it is tied to digital ground.

The digital grounds are: CNT G, ENC1 G, ENC2 G, SW'D PWR G, SOLAR PANEL G, EXT BATT G, SDI-12 G, SDI-12 G. These digital grounds are connected together on the protection/termination board.

The Chassis Ground is a lug or wire that comes off the protection/termination board. All the surge protection devices connect to the Chassis Ground. The internal metal plates are also connected to the Chassis Ground. There is a 100 ohm resistor between the Chassis Ground and digital ground.

Sensor Setup Examples

The following examples show the details of the 8200 setup for some common sensors. Consult Sutron Application Notes for additional examples. This document is available separately from Sutron.

Tipping Bucket

Sensors:	Counter, Counter1..Counter4
Connection:	One wire to the counter channel, the other to GND
Slope:	0.01 for U.S. 0.25 for metric
RightDigits	2 for U.S. 1 for metric
Measurement Interval:	00:15:00 typical

Note: the values will increase and accumulate with each tip. The rollover is at 32767. To clear the accumulator, use S-System Setup, C-Clear Counters. This will also clear all counters and will affect other rain gauges and encoders that may use counters.

Shaft Encoder (Quadrature)

The following setup is for the Sutron model 5600-0530 Shaft Encoder

Sensors:	ENC1, ENC2	
Connection:	ENC1-1	B - green
	ENC1-2	C - blue
	SWD12(+)	A - red
	GND	D - black
Slope:	0.01 for U.S. (use with 1.0 ft wheel) 0.005 for metric (use with 0.5 meter wheel)	
RightDigits	2 for U.S. 3 for metric	
Measmnt Interval:	00:15:00 typical	

Wind Sensor (with amplifier Circuit)

The following setup is for the Sutron model 5600-201 Wind Sensor

Sensors:	WindSpeed1..4 WindDir1..4	
Connection:	SWD12	+V Supply
	GND	REF
	ENCx-x	WS SIG

	+5V	AZ EXC
	A1+..A4+	AZ SIG
	Install 1 Meg OHM pull down resistor if not on Squarer circuit.	
Slope (WindSpeedx):	0.0980 (m/s)	
	0.2192 (mph)	
	0.3216 (fps)	
	0.1904 (knots)	
	0.3528 (km/hr)	
Offset (WindSpeedx):	0.0	
Slope (WindDirx):	360deg/5V = 72	
Offset (windDirx);	0.0	
RightDigits:	0	
Sample Interval:	00:00:01	
#Samples:	900	
Measurement Interval:	00:15:00	

Chapter 7

How To...

This chapter gives specific examples of how to use the 8200. The examples are meant to match the common situations you will encounter. They are also useful to teach you features of the 8200.

Setup for a simple stream gauging station

Nothing could be simpler than the setup for a simple stream gauging station that uses a shaft encoder. The following setup measures the encoder every 15 minutes and logs the data. The Switch Power Option (PwrMode) is ON to provide 12 volts to the encoder.

```
MEASUREMENT SCHEDULE
 MeasInt:      00:15:00
 SampInt:      00:00:00
 MeasTim:      00:00:00
 SampTim:      00:00:00
 PwrTim:       00:00:00
 #Samples/Set:       10
 #Measmnt/Log:        1
 BasInt:       00:00:00
 BasTim:       00:00:00
 PwrMode:            on

ENABLE/CONFIG/ALARM SENSORS
 Sensor:             xx
 Name:         Encoder1
 Enable:             on
 Measure:            on
 Average:           off
 Log:                on
 Intrvl    :   00:00:00
 Slope:            0.01
 Offset:           0.00
 Elevation:           0
 Right Digits:        2
```

Setup for averaging

To average data, turn *Measure* OFF for the sensor, turn *Average* ON and enter a sample interval and number of samples. The following setup samples the encoder every 5 seconds (SampInt 00:00:05) to compute an average. The average is computed and logged every 15 minutes (MeasInt) aligned 00:00:00 (MeasTim). Samples to Average is 180 because the system will take 180 samples sampling 1 every 5 seconds for 15 minutes (12/min*15 minutes).

```
MEASUREMENT SCHEDULE          ENABLE/CONFIG/ALARM SENSORS
 MeasInt:      00:15:00         Sensor:             xx
 SampInt:      00:00:05         Name:         Encoder1
 MeasTim:      00:00:00         Enable:             on
 SampTim:      00:00:00         Measure:           off
 PwrTim:       00:00:00         Average:            on
 #Samples/Set:      180         Log:                on
 #Measmnt/Log:        1         Intrvl:       00:00:00
 BasInt:       00:00:00         Slope:            0.01
 BasTim:       00:00:00         Offset:           0.00
 PwrMode:            on         Elevation:           0
                                Right Digits:        2
```

To average the data over a different interval from the other measurements, set a Sampling Time and reduce the number of samples to average. The following example will start the sampling one minute before the other measurements are taken and sample for one minute. Note that it in this example Sampling Time could be 00:14:00, 00:29:00, 00:44:00, 00:59:00 which are all equivalent because of the 15 minute measurement interval.

```
MEASUREMENT SCHEDULE
 MeasInt:      00:15:00
 SampInt:      00:00:05
 MeasTim:      00:00:00
 SampTim:      00:14:00
 PwrTim:       00:00:00
 #Samples/Set:       12
 #Measmnt/Log:        1
 BasInt:       00:00:00
 BasTim:       00:00:00
 PwrMode:            on
```

Setup for a simple weather station

The following setup is for a simple automatic weather station. Wind speed/direction is sampled once a second to compute a vector average of 900 samples. The other sensors temperature (Analog2), relative humidity (Analog3) and precipitation (counter) are logged along with the wind data every 15 minutes.

```
MEASUREMENT SCHEDULE
 MeasInt:      00:15:00
 SampInt:      00:00:01
 MeasTim:      00:00:00
 SampTim:      00:00:00
 PwrTim:      00:00:00
 #Samples/Set:      900
 #Measmnt/Log:        1
 BasInt:       00:00:00
 BasTim:       00:00:00
 PwrMode:           off

ENABLE/CONFIG/ALARM SENSORS
 Sensor:             2         3         8        18        22
 Name:          Analog2   Analog3   Counter WindSpeed1 WindDir1
 Enable:             on        on        on        on        on
 Measure:            on        on        on       off       off
 Average:           off       off       off        on        on
 Log:                on        on        on        on        on
 Intrvl:       00:00:00  00:00:00  00:00:00  00:00:00  00:00:00
 Slope:           64.37    100.00      0.01      0.10     72.00
 Offset:         -99.10      0.00      0.00      0.00      0.00
 Elevation:           0         0         0         0         0
 Right Digits:        1         0         2         0         0
```

To make the wind vector a one minute average using the samples taken in the minute before the data is logged, enter the measurement schedule as follows, noting the change to the sampling time and the samples to average:

```
MEASUREMENT SCHEDULE
 MeasInt:      00:15:00
 SampInt:      00:00:01
 MeasTim:      00:00:00
 SampTim:      00:14:00
 PwrTim:      00:00:00
 #Samples/Set:       60
 #Measmnt/Log:        1
 BasInt:       00:00:00
 BasTim:       00:00:00
 PwrMode:           off
```

Compute the Slope and Offset for a Sensor

Most sensors produce an analog output or frequency. 8200 measurements report the values in the units of volts or Hz unless some action is taken to scale the value into its final units. The slope and offset are used to perform this scaling. As long as your sensor is a linear sensor, slope and offset can be used to scale it. (If you have a non-linear sensor and want the 8200 to do the computation, you will need to use the BASIC capability of the 8200). A linear sensor is one that has output that can be graphed as a straight line. Examples of linear sensors are:

tipping bucket
shaft encoder measuring water level
some temperature sensors
some pressure sensors
wind speed/wind direction.

Examples of non-linear sensors are:

most thermistors,
shaft encoder measuring gate opening
stage/discharge computations.

Whenever the 8200 takes a sample or measurement it applies the equation:

value = raw_value * slope + offset.

With slope = 1 and offset = 0 the final value is equal to the raw_value.

To determine the slope and offset for your sensor, you will need to know the sensor output for two different points. This information is typically available on the sensor's data or calibration sheet. These two points are then used to compute the slope and offset. The two points are represented as (x1, y1) and (x2, y2) where x is the voltage or raw reading and y is the corresponding value.

The slope and offset are then computed from these two points as follows:

slope = (y2-y1)/(x2-x1)

offset = y1 - x1*slope,

as long as the "x" values are in the same units as the raw_value.

Consider a wind direction sensor. The sensor is a potentiometer excited by 5 volts. The output at 0 degrees is 0 volts and the output at 360 degrees is 5 volts. (x1, y1) = (0, 0) and (x2, y2) = (5, 360). The slope would be (360-0)(/5-0) = 72 and the offset would be 0 - 0 * 72 = 0.

Some further examples will help demonstrate the use of these equations. Remember that the x values are the raw values (volts, hz, counts etc.) and that the y values are the final values.

A 5 psi pressure sensor has a calibrated span of 36.22 millivolts and an offset of -1.22 mv. This example gives all the information necessary, but is in a different form. We know that (x1, y1) = (-1.22, 0). We know that Y2 is 5 psi but they do not give us the X2 value. Instead they give the span from which we can compute X2 knowing that X2 = Span + X1. Or we can just use the span as it is = X2 - X1. So we have Slope = (Y2-Y1)/(X2-X1) = (5-0)/0.03622) = 138.04 and offset = 0 - (-0.00122) * slope = 0.168. Notice that we converted the millivolts to volts before using the values in the equation because the x values must be in the same units as the raw reading.

Printing the Setup

To print an 8200 setup, the following steps must be performed:

1. Transfer the Setup to a PC (see Upload/Download a Setup later on in this section).

2. Run SETMGR. (See Appendix E for information on SETMGR).

Example: SETMGR SITE34.SET > SITE34.DAT

3. Print the file.

Example: PRINT SITE34.DAT

Schedule Details

The 8200 uses the fields entered in SYSTEM SETUP\MEASMNT SCHED (such as MeasInt and MeasTim) to control the when it measures and averages data from sensors. This section gives a more complete description of how all the measurement schedule fields interact.

The best way to describe the 8200s use of these fields is to give a quick look at the routine the 8200 runs to use the values. This routine has the following steps:

```
1. If PwrMode is ADVANCE, wait for PWRTime.
      Turn on 8200 SW+12

2. Wait for Sampling Time.
      Repeat
         Accumulate Averaged Sensor Values
         Delay for Sampling Interval seconds
      Until #Samples/Set values have been taken or next cycle time has been
reached
      Compute Averages and store into current values.

3. Wait for Measurement Time or proceed if Measurement Time = Sample Time
      Read values from all non averaged sensors, and SDI-12 sensors,
         and store into current values.
        If PwrMode is ADVANCE, turn off SW+12
      If needed, Log all enabled current data
```

Step 1 only applies if the PwrMode in the 8200 is set to ADVANCE. If it is, the 8200 uses PwrTim to determine when it should turn on the power for the sensors. When that time is reached, the switched power is turned on and the 8200 goes on to step 2. If PwrMode is not ADVANCE, the 8200 goes straight to step 2.

In step 2, the 8200 will wait for the next sampling time. This time is computed using SampTim and MeasInt. With SampTim set to 00:00:00 and MeasInt set to 00:05:00, the sampling times will be 00:00:00, 00:05:00, 00:10:00 and so forth throughout the day. If SampTim is 00:01:00 the sampling times will be 00:01:00, 00:06:00 ... 23:56:00 for the day.

In step 2, when the next sampling time arrives, the 8200 goes into a loop to handle all the sensors that need averaging. Each sensor with AVERAGE ON is measured and then the 8200 waits for the interval specified in SampInt before making more measurements. This continued until either all the measurements have been taken or the next cycle time arrives. This latter test is a safeguard to prevent the 8200 from taking too long to make the average.

In step 3, the 8200 measures all sensors with MEASURE ON and then logs the data if required. This starts immediately if the averaging terminated because of the cycle time or if the Measurement Time equals the Sample Time.

With this information in mind, try to predict the behavior of the 8200 on the following setup:

MeasTim: 00:07:30
MeasInt: 00:06:00
SampTim: 00:04:30
SampInt: 00:00:01
#Samples: 180
PwrMode: OFF

Since PwrMode is OFF, we look at SampTim and MeasInt to determine when the 8200 starts its sampling. Given the values above, the 8200 starts its averaging at 00:04:30, 00:10:30 ... 23:58:30 throughout the day. Once it starts its averaging, it will take samples every second (SampInt = 00:00:01) until 180 samples have been taken. This will normally finish at 00:07:29, 00:13:30 and so forth after the 180th sample. With MeasTim set to 07:30:00, the 8200 will finish its sampling at 7:30:00 whether or not it is done with the averaging and then make its measurements of the other sensors and log the data.

What would happen if the MeasTim were set to 00:07:00? In this case the averaging would be cut short by about 30 samples. The average is still computed correctly using the fewer number of samples.

Setup for GOES transmissions

The setup for a GOES station requires entries in the GOES setup and Alarm setup in addition to the normal setup for the station. The following example shows the setup for a GOES station that will transmit in the self-timed mode every 4 hours. Each transmission will send 16 values (#Data/TX ST = 16). Encoder1 is included in the transmission because Group Num is set to x1xx (the second value is 1). If the second value in Group Num were not set to 1, the data would not be transmitted in the self-timed message.

```
GOES SETUP                          MEASUREMENT SCHEDULE
 TX Mode:          TIMED             MeasInt:       00:15:00
 SatID:         00000000             SampInt:       00:00:00
 Internatl:          OFF             MeasTim:       00:00:00
 Format ST:       BINARY             SampTim:       00:00:00
 Carrier ST:        LONG             PwrTim:        00:00:00
 Channel ST:         151             #Samples/Set:         10
 Time ST:       00:00:00             #Measmnt/Log:          1
 Rate ST:       04:00:00             BasInt:        00:00:00
 #Data/TX ST:         16             BasTim:        00:00:00
 DatTmST:       00:00:00             PwrMode:            off
 DatInST:       00:15:00


ENABLE/CONFIG/ALARM SENSORS
 Sensor:               xx        xx
 Name:          Encoder1   Counter
 Enable:               on        on
 Measure:              on        on
 Average:             off       off
 Log:                  on        on
 Intrvl:        00:00:00  00:00:00
 Slope:             0.01      1.00
 Offset:            0.00      0.00
 Elevation:            0         0
 Right Digits:         2         2
Alarm Setup
 Enabled for:       goes      goes
 High Alarm:         off       off
 High Level:        0.00      0.00
 Low Alarm:          off       off
 Low Level:         0.00      0.00
 ROC Alarm:          off       off
 ROC Level:         0.00      0.00
 Deadband:          0.00      0.00
 Group Num:         0100      0100
```

Setup for GOES Random Transmissions

To set the 8200 up for random transmissions, you will add additional information to the GOES setup and use the Alarm setup to define the alarms and data included in the transmission. The following example is for a station that will make an alarm transmission when the water level exceeds 5.25 feet.

The 8200 will make 3 transmissions (#TX/Alarm RR = 3) spaced 4 minutes apart (AlmInRR:= 00:04:00) when the alarm is detected. Then as long as the water level is > 5.25 feet and still in alarm, the transmissions will be made every hour (RA Rate: = 01:00:00)

The setup preserves self timed transmissions with each sensor assigned to Group Num 1. A group 2 is also specified with Encoder1 as the trigger and Counter also assigned to the group. This is the random group that gets sent when Encoder1 goes into alarm.

```
GOES SETUP
 TX Mode:          TIMED
 SatID:         00000000
 Internatl:          OFF
 Format ST:      BINARY
 Carrier ST:       LONG
 Channel ST:        151
 Time ST:       00:00:00
 Rate ST:       04:00:00
 #Data/TX ST:         16
 DatTmST:       00:00:00
 DatInST:       00:15:00
 Channel RR:        151
 RN Rate:       00:00:00
 RA Rate:       01:00:00
 #TX/Alarm RR:         3
 AlmInRR:       00:04:00
 #Data/TX RR:          3
 DatTmRR:       00:00:00
 DatInRR:       00:15:00
```

```
MEASUREMENT SCHEDULE
 MeasInt:       00:15:00
 SampInt:       00:00:00
 MeasTim:       00:00:00
 SampTim:       00:00:00
 PwrTim:       00:00:00
 #Samples/Set:        10
 #Measmnt/Log:         1
 BasInt:        00:00:00
 BasTim:        00:00:00
 PwrMode:            off
```

```
ENABLE/CONFIG/ALARM SENSORS
 Sensor:              xx       xx
 Name:          Encoder1  Counter
 Enable:              on       on
 Measure:             on       on
 Average:            off      off
 Log:                 on       on
 Intrvl:        00:00:00 00:00:00
 Slope:             1.00     1.00
 Offset:            0.00     0.00
 Elevation:            0        0
 Right Digits:         2        2
Alarm Setup
 Enabled for:       GOES       on
 High Alarm:          on      off
 High Level:        5.25     0.00
 Low Alarm:          off      off
 Low Level:         0.00     0.00
 ROC Alarm:          off      off
 ROC Level:         0.00     0.00
 Deadband:          0.00     0.00
 Group Num:         2100     0120
```

Setup for LOS RADIO (POLLED)

You do not need a special setup to use an 8200 in a Radio system. Simply set up the 8200 as normal to make its measurements and log the data. Then at the base station, set up the software to poll the station using its UNIT ID as the path name. You may poll for current data or logged data. (See Chapter 9 for more information on data retrieval).

Setup for Telephone (Speech/Modem)

To set up the 8200 for use on phone systems with both speech and modem capabilities, first set up the 8200 for its measurements and logging. Then use the Modem Setup and Alarm Setup to control its operation over the phone. Remember that the Alarm setup allows you to assign phrases to each sensor value so you must use it even though your station may not have alarms.

The following setup is for an 8200 that operates in either voice or data modes (AnswerMode = VO&DA). The DialIn message says phrase 48 (welcome to the

SUTRON 8200), function ll (speak live data for sensors) and function m (speak the main menu).

Each sensor has the Alarm Setup, enabled for ON which allows the prefix and suffix to be entered for each sensor. The prefix defines what is said before the value is spoken (usually the sensor name). The suffix defines what is said after the value is spoken (usually the units).

```
MODEM SETUP                          MEASUREMENT SCHEDULE
 DialOut:           off               MeasInt:      00:15:00
 AnswerMode:      VO&DA               SampInt:      00:00:01
 Number Rings:        3               MeasTim:      00:00:00
 PhonePass:        DEMO               SampTim:      00:00:00
 DialIn:       :48*,,ll,,m            PwrTim:       00:00:00
 DialOut:                             #Samples/Set:      900
 PhoneNumber:                         #Measmnt/Log:        1
 PhoneNumber:                         BasInt:       00:00:00
 PhoneNumber:                         BasTim:       00:00:00
 Redial:       00:03:00               PwrMode:            on

ENABLE/CONFIG/ALARM SENSORS
 Sensor:              1         4         9        12        24        28
 Name:          AirTemp BaroPress  SolarRad  RainFall WindSpeed   WindDir
 Enable:             on        on        on        on        on        on
 Measure:            on        on        on        on       off       off
 Average:           off       off       off       off        on        on
 Log:                on        on        on        on        on        on
 Intrvl:       00:00:00  00:00:00  00:00:00  00:00:00  00:00:00  00:00:00
 Slope:           64.37      7.61   2000.00      0.01      1.68     72.00
 Offset:         -99.10     -3.49      0.00      0.00      0.00      0.00
 Elevation:           0         0         0         0         0         0
 Right Digits:        2         2         2         2         1         1
Alarm Setup
 Enabled for:        on        on        on        on        on        on
 High Alarm:        off       off       off       off       off       off
 High Level:       0.00      0.00      0.00      0.00      0.00      0.00
 Low Alarm:         off       off       off       off       off       off
 Low Level:        0.00      0.00      0.00      0.00      0.00      0.00
 ROC Alarm:         off       off       off       off       off       off
 ROC Level:        0.00      0.00      0.00      0.00      0.00      0.00
 Deadband:         0.00      0.00      0.00      0.00      0.00      0.00
 Trending:          off       off       off       off       off       off
 Prefix:            200       201       206       152       211       209
 Suffix:            202       205       130       124       209       104
```

Setup for Telephone Alarms

If you want alarms from a station with a telephone/speech modem start with the basic setup for a telephone/speech system. Then change the Alarm Setup, enabled for to DIAL and set a alarm type and limit. This defines the sensor(s) and value(s) that will trigger the alarm.

You will also use the Modem Setup Dialout to define what the 8200 does to anounce the alarm. Use the phone numbers to set who the 8200 will call. The redial field sets how long the 8200 will wait before trying the next number in its list. The DialOut defines what the 8200 will speak to anounce the alarm.

In the example below, an alarm of 50 degrees is set on the temperature. When the 8200 sees the temperature reach 50 degrees it will dial the phone number 555-1212 and speak "This" (174) "is" (127) ...This DialOut is the one defined by IdLivMen.

The 8200 will continue to dial the phone number until the alarm is acknowledged.

```
MODEM SETUP                          MEASUREMENT SCHEDULE
 DialOut:           off               MeasInt:      00:15:00
 AnswerMode:      VO&DA               SampInt:      00:00:01
 Number Rings:        3               MeasTim:      00:00:00
 PhonePass:        DEMO               SampTim:      00:00:00
 DialIn:       :48*,,ll,,m            PwrTime:      00:00:00
 DialOut:         :174:127:168 0      #Samples/Set:      900
:123is:33,,#*,, ll,,m                 #Measmnt/Log:        1
 PhoneNumber:   5551212               BasInt:       00:00:00
 PhoneNumber:                         BasTim:       00:00:00
 PhoneNumber:                         PwrMode:            on
 Redial:       00:03:00
```

```
ENABLE/CONFIG/ALARM SENSORS
 Sensor:              1         4         9        12        24        28
 Name:          AirTemp BaroPress  SolarRad  RainFall WindSpeed   WindDir
 Enable:             on        on        on        on        on        on
 Measure:            on        on        on        on       off       off
 Average:           off       off       off       off        on        on
 Log:                on        on        on        on        on        on
 Intrvl:       00:00:00  00:00:00  00:00:00  00:00:00  00:00:00  00:00:00
 Slope:           64.37      7.61   2000.00      0.01      1.68     72.00
 Offset:         -99.10     -3.49      0.00      0.00      0.00      0.00
 Elevation:           0         0         0         0         0         0
 Right Digits:        2         2         2         2         1         1
Alarm Setup
 Enabled for:      dial        on        on        on        on        on
 High Alarm:      above       off       off       off       off       off
 High Level:      50.00      0.00      0.00      0.00      0.00      0.00
 Low Alarm:         off       off       off       off       off       off
 Low Level:        0.00      0.00      0.00      0.00      0.00      0.00
 ROC Alarm:         off       off       off       off       off       off
 ROC Level:        0.00      0.00      0.00      0.00      0.00      0.00
 Deadband:         0.00      0.00      0.00      0.00      0.00      0.00
 Trending:          off       off       off       off       off       off
 Prefix:            200       201       206       152       211       209
 Suffix:            202       205       130       124       209       104
```

Understand Alarms and Alerts

The 8200 can be set up to detect alarms on sensor values and also to notify you when it detects the alarm. This section describes alarm detection and notification in detail. Anyone using alarms should make sure they understand the concepts presented here.

The user sets alarm conditions by using the *High Alarm*, *Low Alarm* and *ROC Alarm* fields and the associated values *HiLev*, *LoLev* and *ROCLev*. The 8200 tests for alarms each time data is collected from the sensors. If you have High Alarm detection on, the 8200 will use its high alarm test on the sensor value. The sensor will be in High Alarm if the value is greater than or equal to HiLev plus the deadband. The same test is done regardless of whether *High Alarm* is set to ABOVE, BELOW or BOTH. These different settings control when to notify you of the alarm, not how the data is tested.

For *High Alarm* you should interpret the settings as follows:

OFF - don't do any high alarm tests

ABOVE -- do the high alarm test and give me an alarm transmission when the sensor goes <u>above</u> *HiLev* plus *DeadBnd* (into alarm)

BELOW -do the high alarm test and give me a transmission when the sensor goes <u>below</u> *Hilev* minus *DeadBnd* (out of alarm)

BOTH - do the high alarm test and give me a transmission when the sensor goes into or out of alarm

In a similar manner, if you have *Low Alarm* on, the 8200 will use its low alarm test on the sensor value. The sensor will be in Low Alarm if the value is less than or equal to the *LoLev* minus the deadband. The same test is done regardless of whether *Low Alarm* is set to ABOVE, BELOW or BOTH. These different settings control when to notify you of the alarm, not how the data is tested.

For *High Alarm* and *Low Alarm,* ABOVE means transmit when the value goes above the level plus the deadband and BELOW means transmit when the value goes below the level minus the dead band. ABOVE and BELOW **do not** control whether the sensor is in alarm when ABOVE or BELOW the value -- that is done by *High Alarm* and *Low Alarm*.

Rate of Change alarms are a bit different in that ABOVE and BELOW do change the type of test that is made. The rate of change alarm compares the absolute value of the current value minus a previous value with the *ROCLev*. If *ROCAlarm* is set to ABOVE,the sensor will be in alarm and you will be notified if the computed change is >= ROCLev. If *ROC Alarm* is set to BELOW, the sensor will be in alarm and you will be notified if the computed change is <= *ROCLev*. Note that the test is different for *ROCAlarm* set to ABOVE and BELOW. This is different from the situation with *High Alarm* and *Low Alarm* where ABOVE and BELOW did not change the test, only the notification.

The previous discussion speaks of alarm notification without describing the fact that you need to set up this notification in order for it to happen. There are several things that must be set for the notification to take place:

telephone	Set the ALARM OPTIONS\Enable to DIAL for the sensor you are testing. Make sure that MODEM SETUP\Dial-Out Enable is ON. Use the Dial-Out message to control what the 8200 does. Use the options in the phone number to control whether the dial out is to use the voice or modem or both.
radio	Set the ALARM OPTIONS\Enable to RADIO
Satellite Radio	Set the ALARM OPTIONS\Enable to GOES for the sensor you are testing. Make sure you set up GROUPS with this sensor as a trigger. Make sure GOES SETUP\TXMode is Random or Both

The 8200 alarm status is set to ALERT whenever it is trying to notify you of an alarm. This status changes back to ALARM or NORMAL when the notification is complete. For telephone systems and radio systems, the notification is complete when the alarm is acknowledged. For satellite radio systems, the notification is complete as soon as the burst of transmissions have been made. The status will go to NORMAL only when all alarms have been cleared.

Make an Event Driven System Using Alarms

The basic idea behind an event driven system is to have a transmission every time a sensor value changes. The most common event driven systems use LOS radios for communication; however, you can also have event driven systems using telephone or GOES. The event driven system setup below makes a transmission every time the value for precipitation or stage changes. If there is no change in the level for 8 hours there is also a transmission.

```
PROTOCOL SETUP                  MEASUREMENT SCHEDULE
 MasterId:         BASE          MeasInt:      00:15:00
 CarrierDly:          7          SampInt:      00:00:00
 ReplyDly:            0          MeasTim:      00:00:00
 Ack Delay:         100          SampTim:      00:00:00
 TN Rate:      08:00:00          PwrTime:      00:00:00
 TA Rate:      00:00:00          #Samples/Set:       10
 RetryIn:      00:00:00          #Measmnt/Log:        1
 # Retries:          0          BasInt:       00:00:00
                                 BasTim:       00:00:00
                                 PwrMode:            on


ENABLE/CONFIG/ALARM SENSORS
 Sensor:              6         8
 Name:         Encoder1   Counter
 Enable:             on        on
 Measure:            on        on
 Average:           off       off
 Log:                on        on
 Intrvl:       00:00:00  00:00:00
 Slope:            0.01      0.01
 Offset:           0.00      0.00
 Elevation:           0         0
 Right Digits:        2         2
Alarm Setup
 Enabled for:     radio     radio
 High Alarm:        off       off
 High Level:       0.00      0.00
 Low Alarm:         off       off
 Low Level:        0.00      0.00
 ROC Alarm:       above     above
 ROC Level:        0.01      0.01
 Deadband:         0.00      0.00
```

Notes: this example sets up ROCAlarms on each sensor. The ROC level is set so that any change in the value causes a transmission. The level can be changed to 0.02 or higher to increase the amount of change that must take place for there to be a transmission. With #Retries set to 0, the station will not repeat the transmission.

One further improvement on this setup would be to make it so the station would sample the sensors every 30 seconds instead of every 15 minutes. Data will still be stored in the log every 15 minutes. This way the transmission will be made as soon as the change in the data happens, within 30 seconds.

```
MEASUREMENT SCHEDULE
 MeasInt:      00:00:30
 SampInt:      00:00:00
 MeasTim:      00:00:00
 SampTim:      00:00:00
 PwrTime:      00:00:00
 #Samples/Set:       10
 #Measmnt/Log:       30
 BasInt:       00:00:00
 BasTim:       00:00:00
 PwrMode:            on
```

Use an External Modem with the 8200

8200's which are not equipped with internal modems can be used with external modems. By connecting an external modem it is possible to call a remote station and recover data and/or program the unit. It is not possible to support alarms or speech with an external modem.

To use an 8200 with an external modem, do the following:

- set the Serial field in the EEROM setup sub-menu to USER or EXT MODEM (EXT MODEM adds login prompts to a user dialed-in.)
- set the User Rate field in the same sub-menu to the appropriate baud rate for the external modem.

> NOTE:Do NOT set the Serial field to MODEM! The MODEM selection is only for use with the internal modem and makes an 8200 emulate at Hayes-compatible modem.

Use the following cable to hook an 8200 to an external modem:

MODEM 25-Pin Male	8200 9-Pin Male
Pin 2,Txd	Pin 2,Txd
Pin 3,Rxd	Pin 3,Rxd
Pin 7,Gnd	Pin 5,Gnd
Pin 8,CD	Pin 4,Dsr/Cts

On a Hayes-compatible modem DTR should be held high by a jumper/switch because of the way the 8200 answers the phone. Close switch 1 on a "real" Hayes modem.

UPLOAD/DOWNLOAD a setup

UPLOAD sends a setup from the PC to the 8200. Follow these steps if you have a PC connected directly to the 8200 or have dialed into an 8200 with a telephone modem. If you have a two way radio system, you will need to use other software provided by Sutron. Contact customer service for additional information.

1. The PC needs to be running TS8210 or other communications program with X-MODEM or Y-MODEM capabilities. Connect to the 8200 and make sure you are able to display and select menus.
2. Select U Upload/Download from the main menu
3. Press T Transfer Setup
4. Wait for the TS8210 Transfer Menu or press F3=XYMODEM
5. Select SEND FILE, press OK and enter the name of the file containing the setup to send to the 8200.
6. Watch the transfer and the COMPLETED message.

DOWNLOAD gets the setup from the 8200 and puts in on the PC disk. Follow these steps:

1. The PC needs to be running TS8210 or other communications program. Connect to the 8200 and make sure you are able to display and select menus.
2. Select U Upload/Download from the main menu
3. Press T Transfer Setup
4. Wait for the TS8210 Transfer Menu.
5. Press ENTER (no changes to defaults are necessary).
6. Watch the transfer and the COMPLETED message.
7. The file will be named unitid.SET

UPLOAD/DOWNLOAD a BASIC program

UPLOAD sends a basic program to the 8200. Follow these steps if you have a PC connected directly to the 8200 or have dialed into an 8200 with a telephone modem. If you have a two way radio system, you will need to use other software provided by Sutron. Contact customer service for additional information.

1. The PC needs to be running TS8210 or other communications program. Connect to the 8200 and make sure you are able to display and select menus.
2. Select U Upload/Download from the main menu.
3. Press B Transfer Basic program.
4. Wait for the TS8210 Transfer menu or press F3=XYMODEM
5. Select SEND FILE and press OK.
5. Enter the name of the file containing the BASIC program.
6. Watch the transfer and the COMPLETED message.

Follow these steps to DOWNLOAD a basic program from the 8200 to the PC:

1. The PC needs to be running TS8210 or other communications program. Connect to the 8200 and make sure you are able to display and select menus.
2. Select U Upload/Download from the main menu.
3. Press B Transfer Basic program.
4. Wait for the TS8210 Transfer menu and press ENTER.
5. Watch the transfer and the COMPLETED message.
6. The file will be named unitid.BAS

Store and forward and cross device repeating SSP messages

The 8210 can store and forward SSP messages either back out the same port ("smart repeating") or out another port ("cross device repeating"). Smart repeating is used in LOS radio systems to send a message to a site which is on the fringe of reception or out of range by using a third site in the middle. For instance if site A cannot reach site C, but site A can reach site B and site B can reach site C - then smart repeating can be used to send from site A to site B and then on to site C.

To set a PCBASE2 master station to use store and forward, set the radio path with the names of the destination and repeating stations separated by "_". For the previous example, the radio path would be: B_C (read this as to site B then repeat to site C). Multiple repeaters can be specified by chaining them together: B_C_D_E would send a message to B first which would repeat it to C which would repeat it to D which would repeat it to E. One draw back to smart repeating is the hop-delay. Each hop requires time to receive and then retransmit the message. At 1200 baud it may take 10 extra seconds per hop for a long message. Ack delays and response timeouts must be increased proportionally.

An 8200 automatically replies using whatever source the message originated from including all the repeating stations. If you want the 8200 to originate an alarm message using the store and forward capabilities, you must add the names of the repeating stations to the PROTOCOL SETUP\MASTER ID.

Cross device repeating allows a message to be received on one device and repeated out another. This could be from one radio to another or even from a telephone modem to a radio. A radio in the first 8210 card slot would be using device AUX:, a radio in the second slot would use COM:, an external radio connected to the RS-232 port would use TERM:. The syntax for sending a message to site C reachable thru site B's radio in the first slot would be: B_AUX:C (read this as to site B repeated out AUX: to site C).

Under SSP a repeater will never attempt to retry a message, it is the responsibility of either the source or the destination to attempt retries.

9-Pin Interface Cable For IBM-AT Type Computers

Below, we have detailed the specifications necessary to build a reliable 8200-to-PC interface cable for those of you who would like to do so. We should note, though, that this type of cable is available for just a few dollars from most any computer/electronics store.

9 -Pin INTERFACE CABLE

PC/AT	8200
9-Pin Female	9-Pin Male
Pin 2,Rxd	Pin 2,Txd
Pin 3,Txd	Pin 3,Rxd
Pin 5,Gnd	Pin 5,Gnd
Pin 4,Dtr	Pin 4,Dsr/Cts
Pin 6,Dsr	Pin 6,Dtr/Rts
Pin 8,Cts	Pin 8,Dtr/Rts

25-Pin INTERFACE CABLE

PC 25-Pin Female	8200 9-Pin Male
Pin 3,Rxd	Pin 2,Txd
Pin 2,Txd	Pin 3,Rxd
Pin 7,Gnd	Pin 5,Gnd
Pin 20,Dtr	Pin 4,Dsr/Cts
Pin 6,Dsr	Pin 6,Dtr/Rts
Pin 5,Cts	Pin 8,Dtr/Rts

Chapter 8

Installation

This chapter describes the factors that must be considered in order to properly install the 8200. The topics covered include environmental protection, power budget, cabling, lightning protection, bench testing and field testing. Use this chapter as a guide as you prepare for your own stations.

Environment/Enclosure

The 8200A and 8210 is designed to withstand temperature extremes but should be protected against direct exposure to rain and dust. If you plan to install the 8210 outside, order it in the modular mount configuration (8210-0014-2). This configuration fits nicely into NEMA-4 or IP65 type enclosures available from Sutron and others. If the 8200A is installed outside, it should be placed in an environmentally sealed Nema 4 type enclosure, providing adequate protection from the elements. If the 8200 is installed inside another structure such as a gage house, then the 8200 can be installed without an additional enclosure or an enclosure such as the Sutron Alternate Enclosure may be used. The advantage to using an enclosure even for indoor installations is that the enclosure provides a way of organizing batteries, cables and protecting them from inadvertant handling.

When using an enclosure, it is good practice plan for the cable entrance/exit in the bottom or sides of the enclosure. Avoid cables entering the top of the enclosure as this promotes leaking. For outdoor installations, cables should enter the bottom of the enclosure. Plan on using liquid tight fittings around cables to create a seal around the cable and the enclosure.

After determining the location of the site, the actual orientation of the 8200 should be planned. The 8200 LED can be difficult to read in very sunny conditions. Try to locate the 8200 where direct sunlight will not shine on the display.

For GOES or LOS radio 8200s, a gell-cell type battery may be placed in the same enclosure as the 8200. This type of battery is designed to recapture the gasses that result from charging the battery. Some other batteries however, will release the gasses into the enclosure. If the battery has a vent hole on it then this should be connected to a tube and routed outside the enclosure. If the battery does not have a vent hole and is not a "sealed" type battery, it should be placed outside the enclosure.

Power Budget

The power budget is an analysis of how much power the 8200 requires. The analysis is required to determine how long the 8200 will operate from the battery without recharging and what size solar panel (or charging source) should be used.

The 8200 uses different amounts of power depending on what it is doing. The only way to come up with the power budget is to determine how much time the 8200 spends in each of its tasks and how much power is used doing each task. The following list shows the power used by the 8200 in some typical tasks. Please note that the consumption is approximate:

Quiescent (basic model): 0.25 ma
Quiescent GOES: 10ma
Quiescent LOS: 30ma
Measuring: 5-30ma
Transmitting GOES: 3500 ma

Transmitting LOS: 2500 ma
Telephone OFF HOOK: 50ma
Display ON: 300 ma

To find the power needed by a site, add up all the power required by each of the tasks taking into account the percent of time spent in each task. The best way to do this is to make a table (or spreadsheet) listing each of the tasks, current and times as shown below for a GOES 8200 that collects data every 15 minutes and transmits once every 4 hours.

Task	Current	Percent Time	Average Current
Collecting	30ma	5sec/900 sec 5 seconds to collect every 15 minutes	0.2
Transmitting	3500	45sec/14400 sec 45 second tx every 4 hours	10.9
Quiescent	10ma	100% (always)	10
		Total Average Current	21.1 ma
		Total Average Power (current * 12VDC)	253 milliwatts

Remember to add in the power required by sensors.

You can see that we had to estimate the amount of time spent collecting, transmitting as well as the power required for collecting. It is best if you come up with these numbers yourself using actual measurements of the power consumption for an operating 8200. Once you have a value for the average consumption, record it and use it as a reference when troubleshooting a station. A site that shows a marked change in power consumption warrants a closer look.

Note: Remember and use the simple equation:

Power = current * voltage

and keep the units straight. If current is in milliamps than power is in milliwatts.

Once you have the average power required by the 8200 you are able to make two important calculations. First compute the battery capacity. To do this, divide the battery capacity by the average power needed by the 8200 as follows:

- battery duration = battery capacity/8200 Average Current

Example: Compute the battery duration for a 24 amp-hr battery powering an 8200 with average power consumption of 50 ma.

- battery duration = 24000ma-hr/50ma = 484 hrs

Since you cannot use 100% of any battery the actual duration will be less. We recommend you only plan on using 75% of the capacity of a battery which reduces the actual duration by 25%. In our example, the 484 hrs duration would become 363 hours.

The size of the solar panel needed for the site depends on both the average power needed and the location of the site. As a general rule of thumb, use a panel that provides at least 10 times the average power needed.

Example: Size a solar panel for a site with average current of 50ma.

- Power needed = 10 * (current * voltage) = 10 * (50ma * 12 volts) = 6000 mwatts
- The minimum size panel should have an output of at least 6000 milliwatts. A 9 watt panel should work just fine.

Note that the internal charger in the 8200 has a maximum output of 0.75 amps or 9 watts. If you need to use a solar panel larger than 9 watts with the 8200 you should use an external regulator.

Cabling

Many sites have serious problems because of bad cabling. The following points should be considered as you plan and install your cabling:

1. Keep cable length to a minimum. The shorter the run, the less chance of signal degredation.

2. Use shielded cable especially if the run is greater than 75 feet. The additional cost is minimal compared to the cost of logging bad data.

3. Bury the cable when possible. Make sure, however, that the cable used is rated for direct underground burial. If not, conduit should be used to protect the wires.

4. Strip and tin (tinning is another term for soldering.)the ends of the wires that connect to the 8200. If the ends are not tinned, the wires might frey causing a bad connection and potential signal loss.

5. Finally, the most common mistake made when connecting to the 8200 occurs when the insulation is securred instead of the bare wire rusulting in a bad connection.

Surge and Lightning Protection

A major factor in keeping a site fully operational for extended periods of time is proper grounding. Static electricity and other transients from nearby storms or high voltage power lines can cause a variety of problems in the 8200 if the site is not grounded properly. Good grounding is the most important way to protect a site from damage caused by transients and to insure its long-term operation. The guidelines listed should be followed when an installation is performed.

1. Use long ground rods. The idea behind earth grounding is to drive the rods far enough into the ground so the metal comes in contact with the grounds' own moisture. Because of this, exact lenghts of the rods may vary, therefore you must have a good idea of current conditions such as precipitation amounts and ground moisture levels to make the best judgement on the length of the rods. As a general rule of thumb, the longer the better.

2. Use more than one rod. In some instances it may be necessary to create a grounding array of up to four rods all of which are tied together by a heavy gage copper wire (10-12 AWG). Remember to not compromise length for numbers. It is far better to have one 8 ft. grounding rod than four 2 ft.rods.

3. After tying the rods together with copper cable, connect another piece of the copper wire to a rod and bring it inside to be connected to the logger and sensors if necessary. There is a ground lug located on the lower left hand corner of the 8200 which can be used to connect to. When bringing the wire into the gage house or Nema Enclosure, try to keep bends in the wire to a minimum since lightning tends to follow a straight pathway.

4. At stream gaging stations, do not solely ground to the stilling well. It would appear logical that the best ground one could have would be the river or stream at the site, however, when a close by lightning strike occurs on the water, the transient travels freely through the water, to the metal float, up the steel tape, into the shaft encoder, then finally into the logger. This information has been obtained from various field people who have indicated this being a source of problems, therefore, it is suggested that the earth grounding guidelines listed above be followed and grounding to the stilling well only be used as a last resort.

Bench Testing

A complete station consists of sensors, wiring, 8200, power supplies, communications and setup or programming. Sutron recommends that each station be tested on a "bench" setup (in the office) before it is put in the field. There are countless stories of persons traveling hundreds of miles to install a station who cannot complete the task because of a missing cable, incompatible sensor, or incomplete programming information. The most important lesson from these wasted trips is to "bench" test the system (hardware, sensors and setup) as far as possible before trying to install the station.

A good bench test will connect the actual sensors using the actual cables. Create and follow a wiring diagram for the connection of the sensors. Fill out and use the 8200 setup sheet. As stated in Section 5, the setup sheet is the tool used to specify the details of the 8200 setup. The best place to create the setup sheet is on the bench with as many of the sensors connected to the 8200 as possible.

Most of the commonly used sensors have been interfaced to the 8200 and typical setups for them are located in the "How To" section in this manual. If not, contact Sutron for an Application note that Sutron may have written for the sensor. If by chance you have picked a sensor which we have yet to interface with, our Applications Dept. will do their best to assist in the interfacing. We do ask, if this is necessary, to send us one of the sensors you are trying to use so we may connect it to the 8200 in our lab and develope the appropriate application note.

You will want to activate the station so it makes its measurements, logs data and even transmits. Vary the sensor inputs to make sure that the conversion to engineering units and other processing is correct. If the station is part of a network of stations, set the base station up to handle the data. A common error is that the base station software is not configured properly to receive and process data from the station when it is installed. Then when the base station is setup an error is encountered which requires going to the station to change the setup. Running tests on the bench help to insure that the data from the field stations is handled properly.

If your setup uses alarms, you will want to adjust the sensors to measure at alarm levels. Note how the 8200 handles the alarms to make sure that it is working the way you want.

Test Before you Leave

Chapter 5 gives the basic steps to setting up an 8200. Naturally, after entering the setup and activating the station, you will want to check the station out before you leave. These checks should include at a minimum:

1. View data from each sensor and make sure the values displayed are correct. If not, there may be an incorrect number entered in the "Config Sensors" submenu or there may not be a good connection to that sensor.

2. View logged data for each sensor and make sure the values are correct.

3. Use a DVM to insure the charging voltage is present.

4. Go to the "Inspect System " menu and then to the "Display Status" submenu. Perform a Display Status and verify there are no error messages, tripped failsafe, or any other message which would lead you to believe that something may be wrong with the 8200. Also observe the messages which provide the Transmission (Random and Self-Timed) schedules and make sure the next Tx times are going to occur when you believe they should. Note the number of resets and use this as a reference for later visits.

5a. If you have a GOES unit, it is advisable to perform a forced transmission to ensure proper operation of the Goes transmitter section and verify the external battery has enough capacity to allow a transmission. Make certain when forcing self-timed transmissions, that you transmit into a dummy load to keep from interfering with another DCP. Connect a voltmeter directly to the battery and observe the voltage drop while the transmissions are taking place. If the voltage drops much more then 1/2 of a volt, the battery is suspect and should be changed to avoid future problems. When forcing random transmissions, it is advised to transmit through the antenna and verify your downlink received it before you leave the general location of the site.

5b. If you have a telephone system, have someone dial the station, make sure it answers in the proper mode and communicates the data properly.

5c. If you have a LOS radio system, have the base station poll the station and display the system status to look at communications statistics.

6. Contact the base station to make sure data are being received properly.

7. Make sure the date and time are correct. The time for GOES units should be exact.

8. Press ON/OFF and make sure the Recording ON message is displayed (or ON&TX) for GOES units.

GOES Antenna Pointing

It is important to properly aim the antenna at the satellite in order to insure the best performance of the transmitter. To determine the direction in which the antenna of a GOES DCP should point, both the location of the GOES spacecraft subpoint (available from NOAA-NESDIS) and the GOES DCP must be known. The transparent overlay, map, and other aids provided in Appendix D enable the user to determine the antenna azimuth and elevation angles for any geographical location.

The azimuth and elevation are determined by placing the transparent overlay over the map so that the center point of the overlay corresponds to the location of the spacecraft on the equator. The location of the GOES DCP is then marked on the overlay. Scales on the overlay indicate the required antenna azimuth and elevation. Elevation angle is marked out from the center of the overlay. Azimuth angles are around the outside edge of the overlay. Angles read from the overlay must be corrected for local magnetic variation. Diagrams are provided to help in making the correction. The following example illustrates the process.

Assume a site is located at 40° north latitude and 80° west longitude and a satellite is located at 70° west longitude. Antenna pointing can be determined using the following procedure:

- refer to the figure in Appendix D which has the overlay superimposed on the map in the correct location;
- locate 40° north latitude and 80° west longitude;
- read elevation and azimuth (elevation = 43° off horizon and azimuth = 176° true); and,
- compute the magnetic direction;
- (deviation is ~ 5° west for the area determined from a local topographic map such as available from the USGS).

By following these steps, it may be determined that

azimuth = 176° true + 5° = 181° magnetic.

Chapter 9

Retreiving Your Data

This chapter describes the different ways you can use to retrieve data from an 8200. The different ways include RAM Cards, PCs, radio communications, telephone communications and satellite communications. Review this chapter to make sure you know all the ways to retrieve data from the 8200.

Introduction

There are many ways to retrieve data from the 8200. This chapter presents all the ways that we know of. You may be able to figure out a few of your own. There are three basic types of readings that the 8200 can communicate: live readings, last measured value and logged data. The retrieval of each of these three types of data is discussed.

Live Readings

Live readings are available only through the 8200 menu. As a result, you can only see live readings from the front panel, test set or through a telephone/speech modem. Live readings cannot be transmitted over LOS radio or through the GOES satellite. The VIEW DATA\LIVE Readings menu is used to view the data. Using a speech modem, the live data function is selected by pressing 4 in the speech menu. (see page 4-45).

Last Measured Value

The last measured value is available through an 8200 menu and also to LOS radios and GOES random transmissions. The View Alarm is the simplest way to view the last measured value. Note that you need to have the Alarm Enable ON for this to work. You can use this menu from the front panel, test set or a telephone modem. The speech modem can be instructed to speak the last measured value using speech menu keys 6 (list normal sensors) and 7 (list sensors in alarm). The last measured value is included in a GOES random message when the #Measmnt/Log is set > 1. For LOS radios, the ability to report the last measured value is controlled by the Alarm Enable. The radio will report the last measured value for any sensor with Alarm Enable not OFF when it receives the POLL command.

Logged Data

Logged data is the most common data retrieved from the 8200. There are the following methods of retrieving logged data:

- 8200 Menus -- VIEW DATA\NEWEST or OLDEST READINGS
- 8200 Speech Menu -- item 5
- Output to an attached printer or recorder -- EEROM\Serial\LOGGER
- LOS radio -- reply to a Time-Tag Data request
- GOES self-timed transmission -- use the setup fields to control how much data is sent. Use the Alarm/Groups to control which sensors are sent.
- GOES random transmission -- use the setup fields to control how much data is sent. Use the Alarm/Groups to control which sensors are sent.

- Dump to serial port or modem -- use the DUMP DATA\Serial Port to start this transfer. Even if you are connected through a modem, the data will be directed to you. Use the startdate to control what data you receive. Remember that the EEROM\LogDump field controls the sending of partial days. If you are running TS8210, the data will be dumped with a simple check at the end. If you are using a modem, we recommend you use a XMODEM or YMODEM transfer so the data is checked every 128 bytes (1024 bytes for YMODEM). See \DUMP DATA\Serial Port for details. If the transfer is in Binary, it will be in a special LOG format. This format has a header at the beginning of the file which is followed by all the data. Sutrons LOGPLOT and LOGPRN programs recognize this format and are useful to display the data (LOGPLOT) or convert it to ASCII (LOGPRN).
- RAM Card -- use the DUMP DATA\RAM Card function to write the data to a RAM Card. Use the Start Date field to control what data gets written to the RAM Card. Remember that the EEROM\LogDump field controls the sending of partial days of data. Note that it may take more than one RAM Card to hold the selected data from the LOG.

> Note: You cannot wipe out or clear out the log using any of these functions. The log itself is managed by the 8200 which will make room for new data at the beginning of each day or when recording is turned on.

RAM Cards

Using The RAM Cards

All 8200 data recorders have been designed to use small RAM Cards to move data from the Log memory to other computers for processing. For the 8210, the RAM cards comply with PCMCIA specifications. You can use cards up to 2MB in capacity. For the 8200, the RAM cards are not PCMCIA and the capacity is limited to 64KB. For both the 8210 and 8200, the RAM cards can hold data and setups from multiple stations.

The most common use of the RAM Card is to retrieve data from a station. If the DUMP DATA\ Auto Dump field is set to ON, the procedure requires a minimum of effort and expertice:

- Make sure the display is OFF
- Insert a RAM Card into the 8200 and press ON/OFF, check the status, and when done remove the card.

The data from the station is added to the RAM card.

If DUMP DATA\Auto Dump is OFF or if you want more control over dumping the data, you can initiate the dump manually:

- Turn ON 8200 display
- Plug a RAM Card into the 8200
- Go to the DUMP DATA menu
- Optionally select a start date for the data dump

- Execute command to dump to RAM Card
- Remove the RAM Card

It is also easy to read the data on the RAM Card into a personal computer. For an 8210 compatible PCMCIA card:

- Insert the card into a PCMCIA port connected to a personal computer
- Execute transfer software to create data files on the PC

If you have an 8200A card, you will need to use the card reader available from Sutron.

The mechanics of transferring data from the 8200 to a RAM Card and from the RAM Card to a PC are described in the following paragraphs.

Transferring Data from Memory to a RAM Card

If you are using a new RAM Card you may need to activate the battery. Slide open the small door which covers the battery. Pry out the battery and remove the plastic insulator. Replace the battery and the cover.

The data transfer from an 8200 to a RAM Card can be done automatically or manually.

For automatic dumping, the DUMP DATA\Auto Dump field must be set to ON. Make sure the display is OFF. Insert a RAM Card. The 8200 will detect the card and automatically dump data to the card. Watch the status messages and check the final status. When done, remove the card. For more information on Auto Dump, see page 4-8.

To manually dump data to a RAM Card, first, insert a RAM Card into the socket. Select DUMP DATA from the MAIN menu. The path to DUMP DATA from the top of the MAIN menu (Sutron 8210 xxvv) is to press the ▼ key until DUMP DATA is displayed. Press ▶ to see Start mm/dd/yyyy, the default starting date for a data dump (month, day, year). You may change the start date at this point by pressing the SET and using the arrow keys to change the date field.

> NOTE: The amount of data dumped depends on the setting of the Log Dump field in the EEROM Setup sub-menu. If DAYBIN is selected the log dump will end at the end of "yesterday". If ALLBIN is selected the dump will end with the last logged data.

After the start date is set and a RAM Card is in place, press ▼ to see the RAM Card dump option. Press the SET key to execute the data dump. If there are no problems you will receive a message of the form:

Complete xxx K

where xxx is the number of K bytes transferred. If the RAM Card is too small to contain the data you will be prompted to insert an additional RAM Card. If you receive an error message refer to page 4- .

The Complete xxx K message will remain in the display until the 8200 times out or you press an arrow key.

Hooking up the RAM Card Reader

Many portable and laptop computers have a built-in PCMCIA card slot. This slot can be used to read the PCMCIA cards used with the 8210. For PCs without a PCMCIA card slot, Sutron can provide a separate card reader. The Sutron RAM Card Reader connects to a serial port on a PC. It allows rapid transfer of data from the RAM Card to files on the PC. Refer to the RAM Card Reader manual for instructions on connecting and operating the reader. Sutron can also provide a RAM Card Reader for non-PCMCIA cards used with the 8200A. See page 9-**Error! Bookmark not defined.** for detailed information.

Using the RAMCARD program (for 8210 PCMCIA cards)

The RAMCARD program is used to read data from an 8210 PCMCIA card into a PC. You should have received the RAMCARD program on a diskette with other utilities along with this manual. RAMCARD can be executed directly from the diskette or you may load it on a hard disk. Following is the screen that is presented when you request RAMCARD help with the command: **RAMCARD /?**

```
RAMCARD File Manager for the 8210       Version 1.0     (C)1995 Sutron Corp

Usage: RAMCARD [d:] [imagename] [/X] [/R filename] [/W filename] [/E]

RAMCARD manages the files on an 8210 PCMCIA Ram Card. If duplicate files are
detected they are automatically renamed. The drive letter of the PCMCIA device
and/or the actual name of the dump file can be supplied, otherwise RAMCARD will
try to find an available drive (starting with D:).

Options:
  By default RAMCARD shows the directory of files on the Ram Card
  d:              - drive letter of PCMCIA device
  imagename       - name of ram card image file to use
  /X              - extracts all files from the Ram Card (same as /R *.*)
  /R filename     - read matching files from the Ram Card
  /W filename     - writes matching files to the Ram Card
  /E              - erases all files from the Ram Card
  /?              - display this help screen

Note: The Ram Card must be preformatted by an 8210 before use.
```

Typically you will set your working directory to the directory you want to extract files to and enter the command: **RAMCARD /X** to extract all the files on the ram card to that directory. RAMCARD will never overwrite existing files, instead it will increment the extension of the filename. For instance if TEST0111.LOG already exists on the disk then RAMCARD will extract TEST0111.LOG from the RAM Card as TEST0111.L01.

File Naming Conventions

The files which RAMCARD creates have names such as:

```
TNKS1104.LOG
REXI1213.LOG
BONY0105.LOG
```

The names consist of the first four characters of the Unit ID and the numeric representation of the start date of the data as mmdd - month/day.

The file name extension .LOG indicates that the data in the file are binary data from the 8200's Log memory. If you attempt to TYPE one of the files you will turn your screen into colored hash or strange symbols. You must now use a program to convert the data to readable form. Refer to the end of this chapter, Converting Data to ASCII.

Converting Data To ASCII (Spreadsheet Usable) Form

Conversion of .LOG files to spreadsheet usable ASCII files is done using the LOGPRN program. You should have received the LOGPRN program on a diskette with your RAM Card Reader. LOGPRN can either be executed directly from the diskette or loaded on to a hard disk.

When you execute the LOGPRN program you will see the following screen display:

```
LOGPRN Convert V1.6 (.Log to .Prn)
Options  -- /X = exclude non recorded data items
         -- /Z = Zero non recorded data items
         -- /S = display Seconds
         -- /J = display Julian day number
         -- /F = fixed column output
         -- /B = insert Blank line between days
         -- /H = output in HYDATA format
         -- /T = output Today's data
         -- /Y = output Yesterday data
         -- /SYYMMDD = specifies start date
         -- /EYYMMDD = specifies end date
Input File:
```

At this point, LOGPRN is expecting you to type in the name of an existing .LOG file followed by a carriage return, for example:

DEMO0101

If you have entered a correct file name, and if the program can locate the file you will see the following messages:

- Creating: xxxxmmdd.PRN
- Reading Descriptor
- Reading Sensor Inf.
- Writing Header
- Writing Data ... Date: mm/dd/yyyy hh:mm:ss
- Complete.

Where xxxxmmdd is the same as the input file name, and mm/dd/yyyy is the current date being converted.

The LOGPRN program allows you to choose several options in the way that data from the RAM Card are converted. The options are selected by typing LOGPRN followed by the option selector. For example:

LOGPRN xxxmmdd /X

You may select more that one option at a time as long as they are not mutually exclusive. The first two options, /X and /Z control the way the conversion of null data items. Null items can either be ignored, or they may be zeroes. The second options control time and date display in the converted data. /S tells the program to time tag to seconds. /J changes the date display from month/day to the Julian numbering system.

The file format is designed to be spreadsheet compatible. When using LOTUS 123 a .PRN file is read in by using the /FIN (File Import Numbers) command. By using the /FIN command the data will be imported in the correct number of columns in numeric form.

Radio Options

External radio support is a standard part of all 8200s. 8200s with the internal radio modem also have additional radio support. The radio support provides the following functions:

- transmit last measured data
- transmit logged data
- upload/download setup
- recording on/off
- set date/time
- change slope and offset
- store and forward message to another station

All communications with the 8200 are done using Sutron Standard Protocol (SSP) which insures error free communications. The communications can be either with a base station or one of Sutron's model 9000 field stations. Other 8200s can also be used as smart repeaters to forward messages to other stations. Sutron has several software products that run on PCs and VAX computers to handle communications. Sutron also has a driver available so that Windows programs such as INTOUCH can retrieve data from 8200s. Consult customer service for details on this software.

Enabling External Radio Support

External radio support is enabled through the Serial field in the EEROM Setup sub-menu. The path to the EEROM Setup sub-menu is:

Menu Path=EEROM SETUP\Serial\RADIO
▼ down arrow as required to reach EEROM Setup
▶ right arrow to enter the sub-menu and Serial

Press the SET key to toggle the Serial field to RADIO.

The baud rate for communications over the external radio is set through the User Rate field of the EEROM Setup sub-menu. User Rate is the second field in the sub-menu. Use

the ▼ own arrow key to move from Serial field to the User Rate field. Use the SET key to toggle the baud rate to the appropriate value.

Connecting To An External Rf Modem

Even if you have used both internal communications slots, an external device can still be added to the 8200. The connection for an external device is to the RS232 port used labeled RS232 (Terminal) on the protection/termination board. The following diagram lists the pinouts for the RS-232 port on the 8200. The connector is a DB9-female.

Pin 2,Txd	Transmit data
Pin 3,Rxd	Receive data
Pin 5,Gnd	Ground
Pin 4,Dsr/Cts	
Pin 6,Dtr/Rts	
Pin 8,Dtr/Rts	

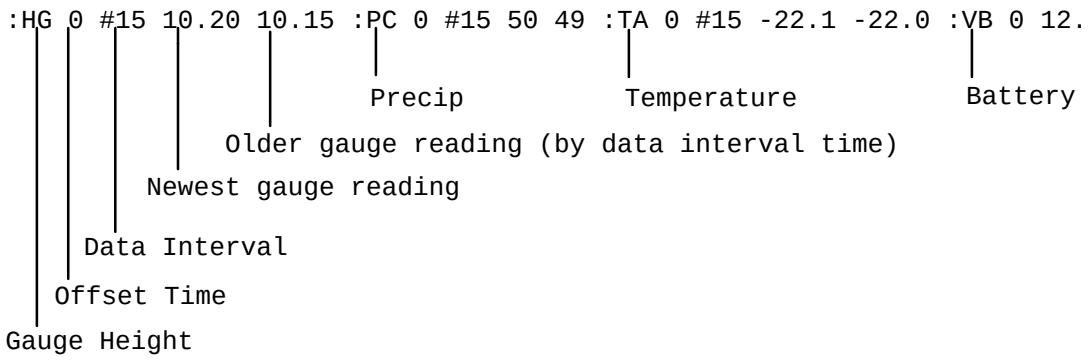
Pins 6/8 are used for transmitter keying. When the 8200 is ready to send a message it will assert DTR. When the message is completed DTR will be dropped. Pin 4 is used to detect incoming messages and to prevent transmissions when another station is on the air. You should normally wire pin 4 of the 8200 to the Carrier Detect (CD) line of the RF modem being used. The RF modem must bring pin 4 high when carrier is detected. Incoming messages are treated as terminal input. When characters appear on the data lines they are simply ingested. The 8200 will not initiate a transmission when Pin 4 is high. The 8200 operates in Carrier Sense Multiple Access mode.

GOES Data

When you have an 8200 with a GOES module, the data can be transmitted over GOES on a self-timed schedule, random/alarm schedule or both. You have complete control over what data is included in each type of transmission and how much data is sent. You also have partial control over the transmission format. The 8200 supports two different formats: standard decimal (also known as SHEF) and binary. The following text gives a brief look at these different formats. For more detailed information refer to Appendix D. Also refer to the GOES RADIO SETUP\# Data Items/TX section of Chapter 4 for information on transmission lengths.

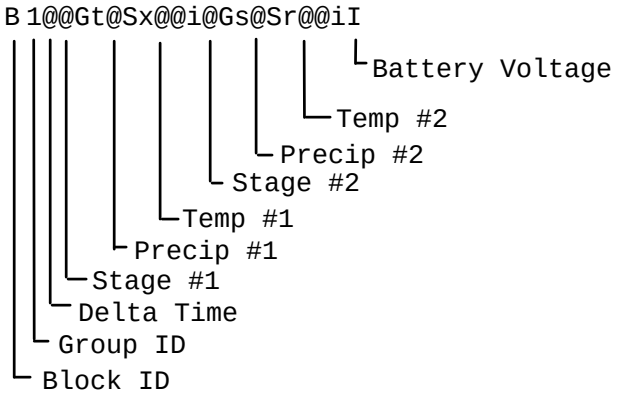
The standard decimal format is human readable while the binary format requires some processing before the values can be read. The standard decimal format is also longer, generally twice as long as the binary transmission. This means that less data can be sent in the same amount of time using the standard decimal format.

An example of a standard decimal format message is as follows. This message comes from a station with three sensors in the self-timed group. The sensors have been named HG, PC and TA. The battery voltage is the voltage of the battery just prior to transmission. It is not the same as the battery sensor that can be enabled in the 8200 sensor list.



The names HG, PC, TA and VB used in the transmission are the names given to the sensors in the 8200. These names default to ones such as ENCODER1, COUNTER and ANALOG1 so be sure to change the name if you want short, specific codes sent in the transmission.

The binary format, as mentioned above, cannot be easily read by a person. A sample binary format message from the same station shown above could be:



The Block ID is always a B for a self-timed binary format message. The group ID informs you that the data comes from group number 1 in the 8200. In this case the transmission has three sensors in the group and two values are being sent for each sensor. The battery voltage is added to the transmission automatically.

Complete information on the transmission formats is given in Appendix D.

Chapter 10

Tiny BASIC

Tiny BASIC is a programming language built into the 8200. You can use it to add special equations and processing to sensor data, do different alarm detection and much more. Tiny BASIC makes the 8200 flexible to handle custom applications, yet easy to use.

Tiny Basic Introduction

Up until this point in the user manual, you have learned about some of the simpler operating procedures behind The 8200. One of its more powerful yet more complicated functions remains to be covered. This chapter will attempt to explain, in some detail, the BASIC interpreter that has been added to the 8200. The BASIC interpreter executes user written instructions coded in a subset of the BASIC language. Because it is a subset of BASIC, it is called TINY-BASIC. TINY-BASIC supports full floating point expressions, control statements, measurements, logging, alarms, custom displays and more. It is fully compatible with the menu driven software. Because this subject does require some prior knowledge of the BASIC language, we ask you to proceed only if you feel you have an adequate grasp of the programming conventions of BASIC.

You will find TINY-BASIC to be especially useful for special conversions on sensors, smart sampling or logging, special alarm detection, control applications, and custom phone-voice messages.

The TINY BASIC language is based on a subset of the BASIC language used on most personal computers. The following are some of the features and limitations of 8200 Tiny Basic:

- Single letter variable names: A-Z
- No string variables or string functions, literal strings are allowed
- Interpreter with immediate mode
- Programs can be entered, modified and tested interactively or transferred to or from a test set.
- Line numbers are required
- Full IEEE 64-bit floating point support
- Full expressions and logarithmic functions
- Single nested FOR...NEXT loops, and GOSUB...RETURN
- Program size may be increased up to 64K bytes
- Sensor values may be accessed directly and/or used as variables
- Unused program memory can be used as data storage

Steps to Running an Existing Program

1. Set the Basic Size option in the EEROM Menu to an appropriate number of KB (1024 bytes) to hold your program, 64 is the maximum size, the default is 1 KB (see Chapter 4, page 4-16 for more information).

2. Download the program using the Upload/Download Data Menu, Transfer Basic Program option, or enter the program interactively using the System Setup, Basic Program option (see 4-78 for more information).

3. Use the System Setup, Enable Sensors menu to change the name of any sensors to the names used in the program. Remember to place a "#" in the beginning of the name of any programmable sensors used in the program

4. In the System Setup, Measurement Schedules menu, set the Basic Run Interval according to how often you wish to run the program, and set the Basic Run Time if you want to add an offset to when the program runs (see 7-44 for more).

5. Turn Recording ON to start your program.

Creating a Simple Program

Most of the you will just need a very simple program which does not require the full power of Tiny Basic. The following are a couple examples of such an application.

Example1. How you can transform an Analog input using an equation.
Let's say you have a sensor connected to Analog1 which must be linearized by applying a polynomial. First you should enable Analog1 and configure it with LOG ON, but MEASURE and AVERAGE OFF. This will allow Tiny Basic to make the measurements. Next enter the following program (or your adaptation of it), using the System Setup, Basic Program Option:

```
> NEW
> 10 A=Measure (Analog1)
> 20 Analog1 = 1.2*A^2 - 0.5*A + 2
```

Line 10 takes a measurement from Analog1 and stores it in to the variable A.
Line 20 applies a polynomial to A and stores the result in to the current value of Analog1.

When the 8200 tries to log Analog1, it will retrieve the last value stored by the program, so you should set your Basic Run Time and Interval so that the program will be run before the 8200 logs. Alternatively you could add line 30 which would make sure that the correct value is always logged either way:

```
> 30 Log Time, Analog1, A
```

If the 8200 has already logged data before the Basic program has been run then line 30 will overwrite the value for Analog1 with the correct data. After your program has been entered, you should exit from Basic with the QUIT command. Set your Basic Run Time and Interval, and turn Recording ON to start the program. Connect a sensor to Analog1 and observe how the converted value is logged. You might notice that when you observe the live reading of Ana-log1 it is not converted, but still reads in raw volts, you will see how you might use sensor variables to correct this in the next example.

Example2: How to create a new sensor from a combination of two other sensors.
In this example we will create a new sensor variable which will compute the percentage ratio of Analog1 to Analog2. In the System Setup/Enable Sensors menu, rename one of the sensors you do not intend to use and call it #TEST. The "#" at the beginning of the name causes the sensor to become a sensor variable, which can be set by our program. When the sensor is measured or viewed it will always return the last value stored (the slope and offset are ignored). Enter the following program:

```
10 #TEST = Measure(Analog1) / Measure(Analog2) * 100
20 Log Time, #TEST, #TEST
```

Line 10 measures and computes the ratio of Analog1 to Analog2, and multiplies by 100 to create a percentage.
Line 20 logs the value to make sure the most recent measurement is logged.

Now you can setup the 8200 to log #TEST, and set the Basic Run Interval and Offset. In a test case like this you can set the Log Interval and the Basic Run Interval to 00:00:10 for quick response. While changing the Analog1 and Analog2 inputs you can observe how the value of #TEST is updated in either the log or live readings every 10 seconds.

Statements

A statement in a basic program consists of a valid basic command with appropriate parameters. All program statements must begin with a line number. Multiple statements on a line may be separated with colons ":".

```
10 A=10' The assignment statement assigns A a value of 10
20 B=20 : C=30' Multiple statements are allowed when separated with colons
30 A=Analog1  ' The last measured value of sensors may be accessed by name
40 Analog1=5  ' The last value may also be changed
50 #MySensor=1' Programmable sensors can be accessed the same way
60 MEM(0)=43  ' The MEM array is a convenient source of extra storage
70 REM remarks can begin with either the word REM or a singe quote: (')
```

Initialization

Variables in Basic are initialized to zero whenever the program is modified, upon system reset, or whenever the program is run the first time by the 8200 after recording is turned on. This allows you to detect when a recording cycle has begun by comparing any variable to 0. The MEM array is only initialized to zero when the program is modified or upon system reset. Hence, the MEM array can be trusted to retain values when recording is toggled. Sensors and programmable sensors are only initialized to zero upon system reset. So, sensors can be used to hold values even when the program is changed. Finally, the slope and offset of a programmable sensor can be used to store fixed constants which the user can easily change. Since the measured value of a programmable sensor is always calculated as: LastStoredNumber * Slope + Offset, you only have to store a zero in the sensor. Future measurements will then return the sensor's offset.

Performance Considerations

Several things can be done to improve the performance of your tiny basic programs, (unfortunately, usually at the cost of readability). If your program is processing at rates greater than once a minute or you otherwise need a boost, you may want to consider some of the following items:

- The variables A-Z are the fastest to use because they are accessed directly.
- The MEM() array is slower to access because of the array index calculation

- Direct access to sensor names is the slowest because the names must first be found in a table before they can be used. As a direct result of this, the sensors at the Analog1 can be accessed faster than Battery, and much faster than SDI9_9.
- You may wish to keep comments out of the code because the interpreter must skip over them each time the program runs.
- Shorter line numbers will be parsed at a faster rate than longer ones.
- A line number cache is maintained so that repetitive line number jumping is quick. This is compared to jumping to a new line number which requires the parser to conduct a search. Line numbers are located using a binary search method, so the search time will vary according to the length of the program and not so much by the position of the line number in the program.
- Using multiple statements on a line reduces the number of bytes which must be parsed.
- Use no more than one space between commands to reduce the amount of whitespace the interpreter has to skip.
- Reducing equations to their simplest forms will help, although extra parentheses should be avoided.
- Move all calculations which only need to be calculated once to the initialization part of your program.

Expressions

Expressions can be used where ever a number or value is required by the program. Expressions consist of numbers, functions, operators, and parenthesis, and follow the normal BASIC syntax including order of operation. Following is a list of operators which Tiny Basic supports inside expressions:

A>B	True (-1) if A Greater than B, otherwise False (0)
A>=B	True (-1) if A Greater than or equal to B, otherwise False (0)
A<B	True (-1) if A Less than B, otherwise False (0)
<=	True (-1) if A Less than or equal B, otherwise False (0)
<>	True (-1) if A Not equal B, otherwise False (0)
=	True (-1) if A Equal B, otherwise False (0)
A^B	Raise A to the power of B. Please note that negative values of the variable A raised to odd integer powers are not handled by this function and this may affect some polynomial equations. For instance (-2)^3 will return 8 instead of -8. If you need to cube a variable X you could use either: 1. X*X*X - or - 2. SGN(X) * X^3 The first example is actually faster for a small power like 3.
A*B	Multiply A by B
A/B	Divide A by B
A+B	Add A plus B
A-B	Subtract B from A
-A	Negate A
A Mod B	Modulas (Remainder of A divided by B)
A And B	Logical/Boolean And of A and B
A Or B	Logical/Boolean Or of A and B

Not A	Logical/Boolean Not of A
A Xor B	Exclusive-or of A and B

Examples

The following examples show Tiny-BASIC at work and suggest codes to handle common programming problems. The 8200 setup is given as well as the 8200 Tiny BASIC code.

Initializing values

Tiny basic programs often accumulate averages or sums of sensor readings. Such programs need a way to initialize and clear out the variables used by the program. Other programs may use a lookup table which may need to be filled in the first time the program is run. Since the program is always run from the start, your program needs a special way to detect a first time program run so that variables can be initialized. Detecting the first execution of a program is easy with Tiny Basic because all variables are set to zero when recording is turned on. Your program should do something like the following:

```
10     If Q=0 Then Gosub 1000 : Q=1 ' Branch off to initialization code
20     ' Place your main code here
999    Stop
1000   ' Place your initialization code here
1100   Return
```

In addition line 65100 is branched to when recording is turned on, and before the program is run for the first time, and line 65101 is branched to when recording is turned off. Termination code must be short or the operating system will automatically abort the operation.

```
10 'normal part of the program
1000 'Place your initialization code here
...
1100 stop
65100 goto 1000
```

Watching the time to measure/log

Often you will want your Basic program to perform an action only during certain times of the day. You can control when your program performs an action by monitoring the Time function. The time function returns the number of seconds since 1/1/85, which by itself is not very useful; however if you can compute much more meaningful numbers using the MOD function. Here are some interesting times you can derive by combining the Time function with the MOD function.

```
Day of the Week:    Int(Time Mod 604800 / 86400) =>
                          0=Mon, 1=Tue, 2=Wed, 3=Thu, 4=Fri, 5=Sat, 6=Sun
Hour of the Day:    Int(Time Mod 86400 / 3600) => 0 to 23
Minute in the Hour: Int(Time Mod 3600 / 60) => 0 to 60
```

Example: Let's toggle switched power every Thursday at 3pm (15:00 hrs)

```
100    ' The program should be run at least once an hour
110    ' Compute D = day of week, and H = hour of day
120    D = Int(Time Mod 604800 / 86400) : H = Int(Time Mod 86400 / 3600)
130    If D = 3 And H = 15 And X = 0 Then Power 1 : Sleep 1 :Power 0 :X=1
140    If H <> 15 Then X = 0 ' X prevents more than one toggle at 15:00 hrs
150    Stop
```

Compute an Average, peak values, and accumulate a sum

Often, you will wish to perform special processing on sensor data which the 8200 can not normally perform. Possible examples include find min and max values, summing a sensor, and calculating daily totals. Fortunately Tiny Basic can accomplish all of these operations. The following is a sample program which calculates hourly average, min, and max temperature, and daily total rainfall.

The following sensor names should be set in the enable sensor's menu for use of the program:

Temp:	Input for measure air temperature (Analog1-8)
Rain:	Input connected to a tipping bucket rain gauge (Counter, 1-4)
#TempAvg:	Hourly average temperature
#TempMin:	Minimum temperature in the hour
#TempMax:	Maximum temperature in the hour
#RainDay:	Total rainfall in the day

The following sensors should have LOG ON and Interval set to 99:00:00: #TempAvg, #TempMin, #TempMax, #RainDay.

The basic run interval should be set to once a minute, and the measurement interval in the measurement schedules menu should be set to one hour.

```
10 If Q=0 Then Gosub 1000 : Q=1    ' Branch off to initialization code
20 T = Measure(Temp)               ' Measure the temperature
30 If T > X Then X=T               ' Calculate max
40 If T < N Then N=T               ' Calculate min
50 S = S + T : C=C+1               ' Calculate new sum increment count
60 A = INT(Time Mod 86400 / 3600)  ' Compute current hour
70 If H=A Then Stop                ' If still same hour then all done
100 #TempAvg = S/C                 ' Compute hourly average temperature
110 #TempMin = N                   ' Compute hourly min temperature
120 #TempMax = X                   ' Compute hourly max temperature
130 Log Time, #TempAvg, #TempAvg   ' Log the hourly average temperature
140 Log Time, #TempMin, #TempMin   ' Log the hourly min temperature
150 Log Time, #TempMax, #TempMax   ' Log the hourly max temperature
160 If H=23 And A=0 Then Goto 200  ' Calculate end of day totals
170 Gosub 1010                     ' Initialize just the hourly parameters
180 Stop
200 B = Measure(Rain) - R          ' Calculate rain fall in the day
210 If B < 0 Then B = B + 32768    ' Handle roll over
220 #RainDay = B                   ' Store daily rainfall
230 Log Time, #RainDay, #RainDay   ' Log the daily rainfall
240 Gosub 1000                     ' Initialize for next time
999 Stop
1000 R=Measure(Rain)               ' Initialize last day rain to current
1010 X=-99999                      ' Initialize max temp to impossibly small
1020 N=99999                       ' Initialize min temp to impossibly large
1030 C=0 ' Initialize number of averages taken to 0
1040 S=0                           ' Initialize sum of temp to zero
1050 H = INT(Time Mod 86400 / 3600)' Remember current hour
1100 Return
```

Interacting with a User

There will often be times when you will want to allow an operator to change the action of a basic program. For instance, after the 8200 reports an alarm that a reservoir level is low, the operator may wish to give a command to the 8200 to turn a pump on. While the 8200 may be programmed to turn the pump on automatically, in many cases it may be advisable to make the 8200 wait for a qualified confirmation before taking such a critical action. The most flexible way a basic program can get input from an operator is by using sensor variables. An operator can set a sensor variable using LIVE READINGS from the front panel, with CONFIG SENSORS value from the test set or dial-up modem, using DTMF codes with the speech modem, or with Sutron Standard Protocol over a LOS Radio.

All your Basic program needs to do is check a sensor variable periodically for a special number, and then take action. For instance the following program will turn the switched +12 volt power on whenever the sensor variable #POWER is set to 1. Set the basic run interval to the minimum response time to the command that you require.

```
100 If #Power = 1 Then Power 1 : Goto 120  ' If 1, Turn the power on
110 Power 0                                ' else turn the power off
120                                        ' All Done
```

You can ask for a sensor value to be entered with the speech modem by using the "?nnn" command in a dial message. This will wait for the user to enter a value for sensor number nnn. A simpler method is to enable the speech menus by placing the "m" command in the dial message. Using this method, the user can then select menu option 8 to enter a sensor number and a new value for the sensor. The operating system will prevent the user from changing anything other than a programmable sensor.

Creating States to control execution

One problem you may have been wondering about is how to perform a variety of tasks under different conditions, all the while using only one basic program. The answer is to

create different states. A state is a variable which contains a number indicating what your program should currently be doing. For instance, if your program must perform 5 different steps in order, a shell of the program might look like this:

```
10 If S=0 Then Goto 100     ' 0 is always the initial value of a variable
20 If S=1 Then Goto 200
30 If S=2 Then Goto 300
40 If S=3 Then Goto 400
50 If S=4 Then Goto 500
60 Stop                     ' Illegal State
100                         ' Perform processing for State 0
110                         ' Determine whether to go to another state:
120 If <some condition> Then S=<next state>
130 Stop
200                         ' Perform processing for State 1
210                         ' Determine whether to go to another state:
220 If <some condition> Then S=<next state>
230 Stop
300                         ' Perform processing for State 2
310                         ' Determine whether to go to another state:
320 If <some condition> Then S=<next state>
330 Stop
400                         ' Perform processing for State 3
410                         ' Determine whether to go to another state:
420 If <some condition> Then S=<next state>
430 Stop
500                         ' Perform processing for State 4
510                         ' Determine whether to go to another state:
520 If <some condition> Then S=<next state>
530 Stop
```

By the way here is an interesting trick using a variable Goto instruction, you can use to replace lines 10 through 60, with the risk that illegal states will cause interesting effects:

```
10 Goto S*100+100
```

When S = 0 line 10 will automatically branch to line 100, when S=1 it will branch to 200, etc. If S was some illegal number such as 0.5 then the program would branch to line 150 causing all sorts of problems.

Of course, you are not limited to just one state in a program, you can maintain multiple state variables to help synchronize all sorts of events.

Custom Phone Handling

When using Sutron's internal Speech/Modem, special processing can be performed by a Basic program when the Modem Setup, Answer Mode is set to BASIC.

The following is a sample program written by Sutron for a customer with a requirement for bilingual speech capability. The program computes min and max stage for the past 24 hour period and will speak the current value to the user in either English or in French depending on a DTMF key the user pressed. The program speaks individual phrases from the Speech vocabulary by printing the phrase numbers just like they would appear in a dial-in or dial-out message. The phrase numbers used in this program are specific to the bilingual application, the customer had a custom vocabulary created for this application. If you try to enter the program yourself you will have to substitute other phrases from the Speech section of the manual, because these phrases do not exist in the standard vocabulary (see 7-51 through 7-54 for more information).

Also be sure to take a close look at lines 100 through 210, which contains a good example of how a Basic program can go back in the log and compute min, max, and average data over the past "n" hours.

The custom phone handling is controlled by program lines 60000 to 60004. These lines are jumped to by the operating system when someone dials-in or when the 8200 needs to dial-out. How the operating system responds when the program stops is determined by the variable Z. Also please note that either MODEM: or VOICE: will be opened already when the vectors are executed, you do not need to explicitly open these devices in this case.

Here is a break down of what each vector does:

Line 60000 is branched to whenever the system needs to determine how to answer an incoming phone call. The following are the return values you can place in Z and what they do:

Z=0 Answer with data first and then voice (7 seconds of carrier)
Z=1 Answer with data only
Z=2 Answer with voice only
Z=3 Answer with voice first (please press pound), and then data

Line 60001 is branched to whenever the system wants to handle a dial-in with voice message. The following are the return values you can place in Z and what they do:

Z=0 Take default action - speak the dial-in message and hang-up
Z=1 Just hang-up (Basic program handled everything)

Line 60002 is branched to whenever the system wants to handle a dial-in with data message. The following are the return values you can place in Z and what they do:

Z=0 Take default action - display system menus.
Z=1 Just hang-up (Basic program handled everything)

Line 60003 is branched to whenever the system wants to handle a dial-out with voice message. Following are the return values you can place in Z and what they do:

Z=0 Take default action - speak the dial-out message and hang-up
Z=1 Just hang-up (Basic program handled everything)

Line 60004 is branched to whenever the system wants to handle a dial-out with data message. The following are the return values you can place in Z and what they do:

Z=0 Take default action - send alarm message.
Z=1 Just hang-up (Basic program handled everything)

```
10 ' Canadian bilingual speech program - 8200 Tiny Basic
20 ' March 10, 1992, Sutron Corporation
30 '
100 ' Calculate Mins & Maxs should be run after each log
105 If #Hours=0 Then #Hours=12 ' Default # hours to go back when ting
106 If #Interval=0 Then #Interval=15 ' Default # minutes between log
107 If #Chart=0 Then #Chart=100.0 ' Default chart datum value
110 P = InAlarm(H, Stage) Or InAlarm(L, Stage) Or InAlarm(R, Stage)
120 If P Then Stop ' Detected a problem with the stage
130 N=1000 : X=-1000 ' Initialize min & max
140 For T=Time-#Hours*3600 To Time Step #Interval*60
150 R=ReadLog(T, Stage) : If Err Or Null Then Goto 180
160 If R>X Then X=R : ' If Reading > Max then Max = Reading
170 If R<N Then N=R ' If Reading > Min then Min = Reading
180 Next T
190 If N=1000 Or X=-1000 Then P=1 ' Found a problem
200 #Min=N : #Max=X
210 Stop
300 ' Subroutine to output the value in English
310 Print ":42:95" ' [Canadian Hydrographic] [Water level announcing
320 Print ",,:91:94:60:58" ' [The] [water] [level] [is]
330 Print S!1!2 ' Output current stage to 2 decimal points
340 Print ":66" ' [meters]
350 Print ",,:33:65:74" ' [a] [maximum] [of]
360 Print #Max!1!2 ' Output max reading to 2 decimal points
370 Print ":66:37:33:68:74" ' [meters] [and] [a] [minimum] [of]
380 Print #Min!1!2 ' Output min reading to 2 decimal points
390 Print ":66:84:45" ' [meters] [were recorded] [during the last]
400 Print #Hours!1!0 ' Output number of hours average is over
410 Print ":54,,:93:94:60:39" ' [hours] [these] [water] [levels] [are]
420 Print ":85:81:44," ' [relative to] [presently adopted] [chart datum]
430 Print ":97:58"  ' [which] [is]
440 Print #Chart!1!2 ' Output chart datum value
450 Print ":66:34:55 19 55" ' [meters] [above] [IGLD] [19] [55]
460 Return
500 ' Subroutine to output the value in French
505 Print "(" ' Switch to french
510 Print ":42:95" ' [Canadian Hydrographic] [Water level announcing
520 Print ",,:91:60:80:94:58" ' [The] [level] [present] [water] [is]
530 Print S!1!2 ' Output current stage to 2 decimal points
540 Print ":66" ' [meters]
550 Print ",,:45 24 :54:91:60:65:84" '[dur last] 24 [hours] [the] [maximum]
[was recorded]
560 Print #Max!1!2 ' Output max reading to 2 decimal points
570 Print ":66:37:33:68" ' [meters] [and] [a] [minimum]
580 Print #Min!1!2 ' Output min reading to 2 decimal points
610 Print ":66,,:93:60:39" ' [these] [levels] [are]
620 Print ":85:91:44:81" ' [relative to][the] [presently adopted] [chart
630 Print ":97"  ' [which is]
640 Print #Chart!1!2 ' Output chart datum value
650 Print ":66:34:55:83 55" ' [meters] [above] [IGLD] [mille neuf cent]
655 Print ")" ' Switch back to English
660 Return
1000 ' Speak [Hello] [press 1 for English] [poussez 2 pour Francais] you]
1010 Print ":52:82(:82)" : SetTimeout 3 : K=Input : SetTimeout 60 : :90"
1020 If K="1" Then L=1 : Z=2 : Stop ' Use English, answer voice
1030 If K="2" Then L=2 : Z=2 : Stop ' Use French, answer voice
1040 If K="7" Then L=0 : Z=1 : Stop ' Anwer in data mode
1050 L=3 : Z=2 : Stop ' Use English and then French, answer voice
1200 ' Routine executed to handle dial in with voice
1210 S=Measure(Stage) ' Measure current stage
1220 If P Then Z=0 : Stop  ' If problem then use default message
1230 If L=1 or L=3 Then Gosub 300 ' Speak English message
1240 If L=2 or L=3 Then Gosub 500 ' Speak French message
1250 If Key Then K=Input : If (K <> "0") And (K <> 27) Then Goto 1210
1260 Z=1 : Stop
1400 ' Routine executed to handle dial in data
1410 Z=0 : Stop ' Use default method
1600 ' Routine executed to handle dial out voice
1610 Z=0 : Stop ' Use default method
1800 ' Routine executed to handle dial out data
1810 Z=0 : Stop ' Use default method
60000 Goto 1000 ' Branch to answer phone routine
60001 Goto 1200 ' Branch to voice dial in message
60002 Goto 1400 ' Branch to data dial in message
60003 Goto 1600 ' Branch to voice dial out message
```

```
60004 Goto 1800 ' Branch to data dial out message
```

Custom GOES formatting with Tiny Basic

To enable Tiny Basic GOES formatting the GOES RADIO SETUP, TX Mode option must be set to BASIC. The operating system will vector to specific line numbers well before a transmission is scheduled. Tiny Basic code can then print any data it would like to be transmitted to a special device called BUFFER:. The program then sets a return code to tell the operating system if everything is ok. Low-level formatting and scheduling is still handled by the operating system. Tiny Basic is only responsible for the "data" part of the transmission.

Synopsis #1 Selftimed: Up to 5 minutes before a self-timed transmision the 8200 will branch to line 60010 in Tiny Basic. Line 60010 should be programmed to GOTO a lower line number which should open the device BUFFER:, initialize the size of the buffer, turn the device on, print characters (to the buffer), turn the device off, set the return code in variable Z, and stop. Return codes are Z=0 (do not transmit), Z=1 (send the buffer), Z=2 (send normal Binary),Z=3 (send normal SHEF ASCII). If Basic takes too long to format the message the transmission will be skipped. Formatting the BUFFER: can be performed long before the transmission in another section of code (which would eliminate the time constraint), but this does not allow for different random & self-timed messages and it is usually desirable to place the most recent data in to the transmission.

Synopsis #2 Random: Just before a random transmision the 8200 will branch to line 60011 in Tiny Basic. Line 60011 should be programmed to GOTO a lower line number which should open the device BUFFER:, initialize the size of the buffer, turn the device on, print characters (to the buffer), turn the device off, set the return code in variable Z, and stop. Return codes are Z=0 (do not transmit), Z=1 (send the buffer), Z=2 (send normal Binary).

The BUFFER: device uses memory in the Basic area at the end of the MEM() array. When you allocate the BUFFER, the number returned by FREEMEM will go down. Be sure to set the Basic Size in the EEROM Setup menu large enough to accomodate the Basic Program, the MEM() array, and the BUFFER. The following snippet of code will open the BUFFER: device, initialize the BUFFER size to 500 bytes, turn it on, print a test string, get the buffers length, turn it off, close it, and then print the length and the buffer to the screen. Printing the length and the buffer to the screen are performed for demonstration purposes, actual formatting code would not do this (of course real code would not just put This is a test message! in the buffer either).

```
1000 Open ‘‘BUFFER:’’              : ‘ Select the BUFFER: device
1010 Control 0,500                 : ‘ Allocate 500 bytes
1020 Control 1                     : ‘ Turn the Buffer: on, resets the
positions
1030 Print ‘‘This is a test message!’’;    : ‘ Print a message. semi-colon
prevents a cr/lf.
1040 Control 4                     : ‘ Request the buffer length
1050 a = Status                        : ‘ Store the length in to a
variable
1060 Control 2                     : ‘ Turn the device off
1070 Close                         : ‘ Deselect the BUFFER: device
1080 Print ‘‘Length = ‘‘; a        : ‘ Display the buffer length
1090 Print ‘‘Buffer  = ‘‘; &b           : ‘ Display the contents of the
buffer
```

Actual formatting s/w will typically read sensor values out of the log using the READLOG function and place the values in the message in specific formats and positions. The PRINT command in Tiny Basic has a number of special options to handle the specific formatting needs of a GOES transmission.

The following example is portions of code that implement a custom transmission format. The code was written so that the 8200 would transmit in the same format as another model DCP. Note the use of line 60010 to branch to line 1000 of the code. The code tests to see if sensors are in the log before trying to format the data from them (see lines 1010-1018, 1790-1800). Line 1020 shows the use of the offset function, used to get from the operating system the offset for a sensor.

```
1000 open "BUFFER:":control 0,600
1002 control 1:control 4:#buf=status
1004 ? "M";
1006 ? &u8;
1008 w=-1
1009 s=(int(time/3600) - 1) * 3600:'(go to previous full hour of data )
1010 'decide to format AQAVG or WATERLEVEL
1012 n = readlog(s,AQAVG)
1014 if not err then w=0
1016 n = readlog(s, WATERLEVEL)
1018 if not err then w=1
1020 if w=0 then ? offset(aqavg)*1000+0.5%3p;
1025 if w=1 then ? offset(Waterlevel)*1000+0.5%3p;
1027 if w=-1 then ? "???";
1030 ? 0%p2;
1035 a=0.0009354011:b=0.0002210605:c=0.000000127472
1040 n=systat("E"): if n>0 then n=3
1045 ? n%p2;
1050 ? systat("N")%p1;
1060 ? systat("C")%p2;
1080 x=0
1090 ' loop for each hour data
1100 gosub 2020:'fmttime
1170 if w>=0 then gosub 1330 :' format primary
1180 gosub 1780:' format ancillary
1190 s=s-3600:'( set time back 1 hour)
1195 control 4:#buf=status
1200 x=x+1
1205 if x<3 then goto 1090
1210 if w=-1 then goto 1300
1215 control 4:#buf=status
1220 if (w>=0) and (status+26 > 528) then goto 1300
1240 'room for atleast one more hour
1245 gosub 2020:'format time
1250 if w=0 then ? ">";
1255 if w=1 then ? 34$;:'print "
1260 gosub 1350:'format PWL with different ID
1270 s=s-3600
1280 x=x+1
1290 if x< 20 then goto 1215
1300 ' all done
1302 control 2:close
1310 z=1:stop
1320
1330 'fmtPWL:
1340 if w=0 then ? "1";
1345 if w=1 then ? "2";
1350 m = 9999
1360 for t= s to s+3599 step 360
1370  if w=0 then n=readlog(t,AQAVG)-offset(aqavg)
1380  if w=1 then n=readlog(t,WATERLEVEL)
1390  if n < m then m=n
1400 next t
1410 m = int((m*1000+0.5)/250)*250:'(round m down to nearest quarter meter)
1420 ? m/250%p1;:' (send m as quarter meters)
1430 for t= s to s+3599 step 360
1440  if w=1 then goto 1570
1450  n=readlog(t,AQAVG)-offset(aqavg):n=int(n*1000+0.5)-m
1465  if null or n>4095 or n<0 then n=4095
```

```
1470  ? n%p2;
1475  if x>2 then goto 1740:'skip following on redundant WL
...
1740 next t
1750 return
1760
1770
1780 'formatANC
1790 n=readlog(s,WINDSPD):n=int(n*10+0.5)
1800 if null or err then goto 1850
1805 if n>4095 or n<0 then n=4095
1810 ? "3";n%p2;
1820 n=readlog(s,WINDDIR)
1830 if null or err then n=0
1835 if n>4095 or n<0 then n=4095
1840 ? n%p2;0%p2;
...
1990 'all done
2000 return
2010
2020 'formattime
2030 ? "0";int(s/86400)%p2;(int(s/3600) mod 24)%p1;
2040 return
...
60010 goto 1000
60011 z=0:stop
65110 ? "  GOES Buffer Size: ";#Buf!1!0 : Stop
65111 ? " ... GOES Buffer Size: ";#Buf!1!0;: Stop
```

Using MEM

The MEM array is available to your programs for extra variable storage and consists of all memory allocated fo r the Basic program, but not currently in use. The MEM() array is automatically initialized to all zeroes when the system is reset or the program is changed, otherwise it retains any data stored. One common use for the MEM array is to store a look up table. The following program demonstrates how the MEM array can be used to implement a rating table with linear interpolation which converts a stage reading to a computed flow:

```
10 if q=0 then gosub 1000 : q=1
100 stage = measure(stage)
110 ' compute the flow using table lookup
120 if stage <= mem(1) then #flow = mem(2) : goto 200
130 for i = 3 to mem(0)*2 step 2
140 if stage <= mem(i) then goto 170 ' go interpolate the
       flow
150 next i
160 #flow = mem(i-1) : goto 200 ' stage greater than
       highest point in table
170 #flow = mem(i-1) + (stage-mem(i-2))/(mem(i)-mem(i-2)) *
       (mem(i+1)-mem(i-1))
200 log time, stage, stage
210 log time, #flow, #flow
220 stop
1000 mem(0) = 15 ' number of points in the table
1010 mem(1) = 3.4 : mem(2) = 0
1020 mem(3) = 4.2 : mem(4) = 3
1030 mem(5) = 4.4 : mem(6) = 7.6
1040 mem(7) = 4.6 : mem(8) = 15
1050 mem(9) = 4.8 : mem(10) = 20
1060 mem(11) = 5 : mem(12) = 28
1070 mem(13) = 5.2 : mem(14) = 40
1080 mem(15) = 5.4 : mem(16) = 54
```

```
1090 mem(17) = 5.8 : mem(18) = 94
1100 mem(19) = 6 : mem(20) = 122
1110 mem(21) = 6.2 : mem(22) = 154
1120 mem(23) = 6.4 : mem(24) = 190
1130 mem(25) = 6.6 : mem(26) = 230
1140 mem(27) = 6.8 : mem(28) = 280
1150 return
```

Communicating with RS-485 sensors

The RS-485 port is accessed thru the TERM: device using special on modes which redirects the data to the RS-485 interface. RS-485 is a half duplex interface which requires software to determine when to drive the signal line and when to just listen. The 8210 supports 3 different modes for handling the RS-485 transmitter and receiver enables:

```
Control 1,3 : ‘ Full software control - on mode  3
Control 1,4 : ‘ Automatic transmitter enable by characters - on mode 4
Control 1,5 : ‘ Automatic transmitter enable by block - on mode 5
```

To enable the RS-485 transmitter (use with on mode 3):

```
Control 26,2
```

To disable the RS-485 transmitter (use with on mode 3):

```
Control 26,0
```

To enable the RS-485 receiver (use with on mode 3):

```
Control 25,2
```

To disable the RS-485 receiver (use with on mode 3):

```
Control 25,0
```

To output the rest of the transmit buffer and disable the transmitter with on mode 5:

```
Control 10
```

Example 1. Here is a short sample program which uses RS-485 on mode 4 to send a string “HELLO” out the RS-485 port and reads in a number.

Warning! This program cannot be run interactively on the RS-232 port - because the TERM: port will not be available for use. It can be run on a scheduled basis or it can be run while logged in thru a modem or connected with a null-modem connector to the internal COM port with slot 2 set to COM MODEM.

```
10 Open ‘‘TERM:’’
20 Control 1,4: ‘ turn port on in mode 4
30 Control 11,9600   : ‘ set port speed to 9600 baud
40 Print ‘‘Hello’’    : ‘ send a test message
50 SetTimeout 2      : ‘ wait two seconds for data
60 A = Input(0)      : ‘ read in a number
70 SetTimeout 0      : ‘ disable timeouts
80 Control 2  : ‘ turn the port off
90 Close
100 #RS485=A  : ‘ save input value in a basic sensor
```

Example 2. Here is a program which will read an SDI-12 sensor thru the SDI-12 interface, and then read another sensor thru the RS-485 interface.

```
10 Open ‘‘TERM:’’
20 Control 12, 0     : ‘ set PROTOCOL SETUP\Use RS-485 to no.
30 Close
40 SDI1_1 = Measure(SDI1_1) : ‘ measure SDI1_1 using SDI-12 interface
50 Open ‘‘TERM:’’
60 Control 12, 1     : ‘ set PROTOCOL SETUP\Use RS-485 to yes.
70 Close
80 SDI2_1 = Measure(SDI2_1) : ‘ measure SDI2_1 using RS-485 interface
```

Tiny Basic Command Set

Command Syntax	Description
AVGDONE ***SensorName***	Computes the average value of SensorName and the following statistics accumulated by calls to AVGSUM: MIN, MAX, STD, SUM, and COUNT. See AVGINIT, and AVGSUM
AVGINIT ***SensorName***	Initializes a sensor for Basic controlled averaging. See AVGSUM, and AVGDONE
AVGSUM ***SensorName*** ex: (check peak battery voltage) 10 AvgInit Battery 20 For i = 1 To 100 30 AvgSum Battery 40 Next i 50 AvgDone Battery 60 ? "Peak Bat = ", Max(Battery)	Measures a sensor and accumulates statistics. See AVGINIT, AVGDONE, MIN, MAX, STD, SUM, and COUNT.
CLOSE	Closes the last device which was opened
CONTROL ***Cmd***[, ***Data***] ex: (set baud rate to 1200) 10 Open "TERM:" 20 Control 11, 1200 30 Close	Sends a standard device control and optionally data to the currently open device. Following are some of the standard commands: 1 : Turn device On 2 : Turn device Off 3 : Detect Carrier and set STATUS 11 : Set baud rate according to Data 12 : Turn LED cursor On if Data is 1, Off if 0 23 : Turns RTS On if Data is 1, Off if 0
CLEARALARM [INT/EXT] ex: ClearAlarm Int ' Ack Internal ClearAlarm Ext ' Ack External ClearAlarm ' Ack Both	Clears and acknowledges internal alarms, external alarms, or both. An internal alarm is one directed to an internal device such as a GOES Radio, LOS Radio, or Speech Modem. An external alarm is one directed to an external LOS Radio connected to the RS-232 port.
CHECKALARM ***SensorName*** ex: (measure battery, check high limit) 10 Battery = Measure(Battery) 20 CheckAlarm Battery 30 If InAlarm(H,Battery) Then Goto 50 40 ? "Not in high limit alarm" : Stop 50 ? "High limit exceeded" : Stop	Compares a sensor's current value to the user defined alarm limits from the system setup - alarm options menu, updates the alarm conditions, and signals transmissions as appropriate. Three types of alarm checks are performed: high limit, low limit, and rate of change. The high and low limit checks will only trigger a transmission if the alarm state changes, whereas the rate of change check can trigger a transmission whenever the limit is exceeded.
DATE year,month,day	Sets the system date.

Command Syntax	Description
DQAP sensor	Allows another sensor other than WaterLevel to have the DQAP average and correction algorithm performed on it.
GOTO ***LineNumber*** ex: (endless loop) 10 Print "Press ESC to stop this!" 20 Goto 10	Branches to a line in the program starting at ***LineNumber***.
GOSUB ***LineNumber*** ex: (call a subroutine to increment A) 10 A=0 : ? A : GOSUB 100 : ? A 20 Stop 100 A=A+1 : RETURN	Executes a subroutine in the program starting at ***LineNumber*** until a RETURN statement passes control back to the point after the GOSUB. note: Subroutines may not be nested.
IF ***expression*** THEN ***statement*** ex: (check battery voltage) 10 A = Measure(Battery) 20 If A<10 Then Goto 40 30 Print "Battery OK" : Stop 40 Print "Battery BAD" : Stop	Conditionally executes a statement, or skips to the next line number if expression is false.
FOR ***var*** = ***start*** TO ***end*** [STEP ***inc***] ex: (print 1 through 10) 10 For i = 1 to 10 20 Print i, 30 Next i	A FOR NEXT loop performs the following steps: 1. Initialize ***var*** to ***start***. 2. Execute any statements following until a NEXT ***var*** statement is found. 3. Increment ***var*** by 1 or ***inc*** if specified 4. If ***var*** is less than ***end*** then go to step 2 note: FOR loops may not be nested.
LIST ***line1-line2*** ex: Some different combinations: LIST ' List whole program LIST 100 ' List just line 100 LIST 100- ' List lines 100 and after L 100-200 ' List lines 100 to 200	Lists the whole program or just part of a program starting from ***line1***up to ***line2*** if specfied. You can use L as an abbreviation for the LIST command You can press ESC to abort a listing.
LOG ***Time***, ***SensorName***, ***Num*** ex: LOG Time, Analog1, -25	Stores ***Num*** in to the 8200 LOG under the specified ***SensorName*** and ***Time***. See the Time function for more information on how to specify a time.
MEM(***index***) = ***number*** ex: MEM(0) = 55.2	Stores a ***number*** in to the MEM array. The MEM array consists of all BASIC memory not consumed by your program lines, and can be used for any purpose. Valid values of ***index*** must range from 0 to FREEMEM-1. Use the MEM function to access a number stored in the MEM array.

Command Syntax	Description
NEW	Erases the current program, does not effect variables or MEM.
NEXT ***var***	Terminates a FOR NEXT loop.
OUT ***Port***, ***Num***	Outputs a byte to a hardware I/O port. **Improper use of this function can cause damage to the operation of the 8200.**
OPEN "Device:" [NOWAIT] ` ex: (open LEDs and display message) 10 Open "DISPLAY:" 20 Control 1 ' Turn on 30 Print "Hello"; ' Display msg 40 Sleep 1 : Control 2 : Close 50 Open "TERM:" NOWAIT 60 If Err Then Goto 90 70 Control 1 : Print "Hello" : Control 2 80 Close 90 Stop	Selects a device for input, output and control functions. The optional NOWAIT parameter will cause the OPEN command to return immediately if the device is not available. The ERR function will return true when this occurs. The following devices are defined by the 8200: TERM:The RS-232 port AUX: The internal serial port MODEM: The speech modem VOICE: The voice synthesizer DISPLAY: The alphanumeric LED display NULL: The NULL device

Command Syntax	Description
PRINT or ? ex: (sample print statements) 10 Print 1,2,3,4,5,6,7,8 20 Print 1;2;3;4;5;6;7;8 30 ? "The value of A+B is:", A+B 40 ? "Hello", : ? "There" 50 X = 1.2345678 : Print X!2!3 60 ? 65$: ' Print the letter "A" 70 ? Measure(Battery)%	Displays strings, numbers and variables to the screen or the currently open device. Multiple items can be displayed by seperating them with commas or semi-colons. A comma automatically adds a space between the items. A comma or semi-colon at then end of a print statement will suppress CR LF. The number of digits left and right of the decimal point can be controlled when printing numbers by following the number with: "!" (see line 50 for an example) , the number of left digits, "!" ,and the number of right digits. Placing a dollar sign "$" after a number will display the ASCII code associated with that number. A percent sign "%" after a number will display only the integer part of the number. Advanced Print Formats: ? &b : 'Prints the current buffer ? &b*nn* : ' Prints the first *nn* characters in the buffer. ? &u : ' Prints the unit id ? &u*nn* : ' Prints the unit id padded to *nn* characters with spaces. ? x%p*n* : ' Prints x in 6-bit binary format using *n* digits (1-6). ? x%*n* : ' Prints x using *n* digits (1-9). ? x%- : ' Prints x as a signed number with a leading blank when x >=0. ? x%_ : ' Prints x as a signed number without a leading blank when x >=0. ? x%+ : ' Prints x as a signed number with a leading plus when x >= 0. ? x%z : ' Print x with leading zeros. ? x%b*nn* : ' Prints x in base *nn* where *nn* is >= 2 and <= 16. ? x%8b2z : ' Combine options to print x with 8 digits in base 2 with leading zero. note: ? is the same as PRINT in Tiny Basic, x can be any variable, *n* or *nn* is meant to represent a number.
POWER ***OnOff*** ex: (pulse the power for 1 sec) 10 Power 1 : Sleep 1 : Power 0	Turns switched +12V power OFF if ***OnOff***= 0, otherwise it is turned ON.
POWER AUX ***OnOff*** ex: (pulse aux power for 1 sec) 10 Power Aux 1 20 Sleep 1 30 Power Aux 0	Turns auxiliary switched power OFF if ***OnOff***=0, otherwise it is turned ON. Auxiliary power is only available on specially modified 8200s, and may not be available on your unit.

Command Syntax	Description
POKE ***Addr***, ***Num***	Stores a byte of data ***Num*** into memory address ***Addr***. **Improper use of this function can cause damage to the operation of the 8200**.
PULSE **Output**,**Seconds** ex: (pulse all the outputs for 10ms) 10 For i = 1 To 8 20 Pulse i,.01 30 Next i	Turns one of the digital outputs on for the specified number of seconds. Valid outputs are 1 thru 8 which map to the sensors OUT1 thru OUT8. The pulse duration can range from 0 (as fast as possible) to 65 seconds with resolution of 0.01 seconds.
PULSE- **Output**,**Seconds** ex: (negative pulse an output) 10 REM you could do this --- 20 OUT1=0 : Sleep .2 : OUT1=1 30 REM but this is more accurate --- 40 Pulse- 1,.2	Turns one of the digital outputs off for the specified number of seconds. Valid outputs are 1 thru 8 which corresponds to the sensors OUT1 thru OUT8. The pulse duration can range from 0 (as fast as possible) to 65 seconds with resolution of 0.01 seconds.
RAISEALARM ***SensorName*** ex: (send an alarm if battery is low) 10 B=Measure(Battery) 20 If B<10 Then RaiseAlarm Battery	Simulates the occurence of an alarm from ***SensorName***, resulting in alarm transmissions appropriate to ***SensorName***. If the sensor is not enabled to transmit in the system setup, alarm options menu, then no transmissions will occur. If the system is already in alert when RaiseAlarm is called, then the system will just remain in alert, and no extra transmissions will be scheduled.
REM or ' ex: (a remark) 10 REM This is a remark 20 ' This is a remark also	Starts a program remark causing the rest of the program line to be skipped. For fastest execution speed, remarks should be placed at the end of the program, so that the interpreter does not need to skip over them.
RETURN	Return from a subroutine. See GOSUB.
RUN	Used interactively to test start a program. Once you have completed your program, the 8200 will automatically run it based on the Basic Run Interval and Time.
RUNLINE ***SensorName,LineNumber*** ex: (apply an equation to Analog1) 10 ‘ normal program goes here 20 ‘ 65100 is run when recording enabled 30 ‘ 1000 is run when Analog1 measured 100 Stop 1000 Z=Measure(Analog1) 1010 Z=10*Z^2 + 5*Z + 2 1020 Stop 65100 RunLine Analog1,1000 : Stop	Causes a sensor to be measured by Tiny Basic. RUNLINE for a particular ***SensorName*** needs to be executed only once, then each time the operating system or Tiny Basic tries to measure ***SensorName*** the operating system will branch to ***LineNumber***. The Basic routine sets the return value to Z and returns. The routine can measure the sensor if needed, because recursion is detected and prevented. When recording is OFF, RUNLINE has no effect.

Command Syntax	Description
SETTIMEOUT ***Seconds*** ex: (allow the user 10 sec to hit a key) 10 SetTimeout 10 20 A=Input 30 If A=33 Then ? "Timeout" : Stop 40 ? "You pressed", A$	Sets a timeout on the current device in seconds, or disables timeouts if ***Second*** is 0. Resolution is to the tenths of seconds, so a timeout value of 0.5 would timeout in one half a second. When a device times out it will always return the ESCAPE character and the TIMEOUT function will become true.
SLEEP ***Seconds*** ex: (pause for 1.5 seconds) 10 ? "Start" : Sleep 1.5 : ? "Stop"	Pauses the program for the specified number of seconds. Resolution is to the tenths of seconds.
SDI "***sdicommandstring***" ex: (send interrogate, print result) 10 SDI "0I!" : ' Interrogate sensor 0 20 I=0 30 If SDI(i) = 0 Then Stop 40 Print SDI(i)$; : i=i+1 : Goto 30	Sends a command string to the SDI-12 port. The response can be read using the SDI() function.
STOP	Stops execution of a program
WAITFOR “pattern”	Waits for a pattern to be detected from the input of the current device or a timeout to expire (see SETTIMEOUT function). Valid patterns are simple strings (case sensitive) with pattern matching options. The "^" character is used to embed a control character in a pattern ex: WAITFOR "^JHello" would wait for a line-feed and then the word "Hello". The "?" character is used to match any input character ex: WAITFOR "B?T" would match the words "BAT", "BIT", or any other 3 letter sequence with "B" first and "T" last. The "*" character will match any number of characters up to the next character in the pattern ex: WAITFOR "B*T" would match any input which began with a "B" and ended with a "T". Finally the "\" character is used to embed one of the special characters in to a pattern ex: WAITFOR "\^*\?\\" would wait for the letters "^*?\" to be received.

Tiny Basic Function Set

Function Syntax	Description
ABS(***Num***)	Absolute value of ***Num***
ARCTAN(***Num***)	Arctangent of ***Num*** in degrees.
COS(***Num***)	Cosine of ***Num*** in degrees.
COUNT(***SensorName***)	The number of samples taken the last time ***SensorName*** was averaged.
ERR ex: (try to read the log) 10 N=ReadLog(Time, Battery) 20 If Err Then ? "Failed" 30 If Not Err Then ? N	True (-1) if the last instruction caused an error, otherwise False (0). ReadLog is currently the only function which sets this status. Open is the only command which sets this status.
EXP(Num)	e^{Num}, (e is approximately 2.71828)
INP(***Port***)	Reads a byte from an input/output port. **Improper use of this function can cause damage to the operation of the 8200**.
INALARM(HI/LO/ROC/INT/EXT, ***Sensor***) ex: (check out Analog1) 10 If InAlarm(H, Analog1) Then ? "H" 20 If InAlarm(L, Analog1) Then ? "L" 30 If InAlarm(R, Analog1) Then ? "R"	Supplies various information about the alarm state of a ***Sensor***. True (-1) if the sensor is in alarm, or False (0) if it is normal. Specify **HI** to check for a HI LIMIT ALARM, **LO** for a LOW LIMIT ALARM, **ROC** for a RATE OF CHANGE ALARM, **INT** to see if the sensor is triggering an alert transmission to the internal goes radio, speech modem, or LOS radio, transmitter, or **EXT** to see if the sensor is traggering an alert transmission to an external LOS radio connected to the RS-232 port. Only the first letter is necessary H,L, R, I, or E.
INALARM(ALARM/INT/EXT) ex: (check system alarms) 10 If InAlarm(A) Then ? "Alarm" 20 If InAlarm(I) Then ? "Int Alert" 30 If InAlarm(E) Then ? "Ext Alert"	Supplies various information about the alarm state of the system. The **ALARM** option returns True (-1) if the system is currently in alarm. The **INT** option returns True (-1) if the system is currently trying to send an alert to the internal goes radio, speech modem or LOS radio. The **EXT** option returns True (-1) if the system is currently trying to send an alert message to an external LOS radio connected to the RS-232 port. Only the first letter is necessary A, I, E,.
INPUT ex. (wait for a key and echo it) 10 A=Input 20 Print "You pressed:", A$	Waits for a key and returns the ASCII code as a number.

Function Syntax	Description
INPUT(n)	allows a number to be read where n is the number of digits to read-in or 0 to terminate on a non-numeric character. Characters which can make up a number include "0"-"9", "E", ""e", "+', and "-". For example if the input stream was "1234567890", then INPUT(5) would read only the first 5 characters and the number 12345 would be returned. If the input stream contained "XXX +12.3E2,56,100.0", then INPUT(0) would return 1230 because it would igore the initial "XXX " and terminate on the first invalid character ",". If a valid number could not be formed then the ERR function will return -1 (or true).
INT(***Num***)	Integer portion of a number
FREEMEM ex 1: Print "Mem Avail = "; FreeMem*8 ex 2 : Initalize the MEM array to zeroes 10 For i = 0 To FreeMem-1 20 Mem(i) = 0 30 Next i	Amount of extra program memory available for storage in the MEM array. Multiply FREEMEM times 8 to get the amount of free memory in bytes.
KEY	True (-1) if a key is available, otherwise False (0)
LOG(***Num***)	Log base 10 of a number
LN(***Num***)	Natural log base e of a number
MAX(***SensorName***)	The maximum value from the last time ***SensorName*** was averaged. In addition MAX(WindSpeed) returns the scalar maximum of speed.
MEASURE(***Sensor***) ex: Print Measure(Battery)	Takes a reading from a sensors, multiplies by the slope, adds the offset and returns the value.
MEM(***Index***) ex: Print MEM(0)	Fetches a number from available free memory. Valid values of ***Index*** must range from 0 to FREEMEM-1.
MIN(***SensorName***)	The minimum value from the last time ***SensorName*** was averaged. In addition MIN(WindSpeed) returns the scalar minimum of speed, MIN(WindDir) returns the scalar standard deviation.
NULL	True (-1) if last READLOG retrieved null or non-recorded data.
OFFSET(sensor)	Returns the offset of a sensor.

Function Syntax	Description
PEEK(***Addr***)	Returns the byte stored at a memory address.
READLOG(***Time, Sensor***) ex: (print battery readings from the start of the day) 10 S=Time - Time Mod 86400 20 For T = S To Time 30 N = ReadLog(T, Battery) 40 If Err Then ? "Error" : Stop 50 If Null Then ? "(null)" : Goto 70 60 Print N 70 Next T	Returns a ***Sensor*** reading from the specified ***Time*** in the log. ERR is set to True (-1) if the operation fails. NULL is set to True(-1) if the data was null Error conditions include the log being empty, the ***Time*** parameter being outside the range of log, or if ***Sensor*** is not in the log.
SDI(***Index***)	Fetches a character from the last sdi result, the end of the string is marked by a 0 byte. The first valid ***Index*** is 0.
SGN(***Num***)	1 if ***Num*** is positive or -1 if negative.
SIN(***Num***)	Sine of ***Num*** in degrees.
SLOPE(sensor)	Returns the slope of a sensor.
SQR(***Num***)	Square root of ***Num***
STATUS	Return code from the last Control command
STD(***SensorName***)	The standard deviation from the last time ***SensorName*** was averaged. In addition STD(WindSpeed) returns the scalar standard deviation of speed, STD(WindDir) returns the vector standard deviation of direction.
SUM(***SensorName***)	The sum of all of the samples taken the last time ***SensorName*** was averaged. In addition SUM(WindSpeed) returns the scalar average of speed, SUM(WindDir) returns the unit vector average of direction.
SYSTAT(ch)	Returns system information based on ch, “C” returns the rom checksum, “E” returns a bitmapped error status, and “N” returns the number of resets. The format for the “E” error status is as follows: bit 0 - Rom Error bit 1 - Ram r/w Error bit 2 - EEROM r/w Error bit 3 - EEROM Checksum Error bit 4 - Analog Error bit 5 - Digital Error bit 6 - GOES Timer Stopped bit 7 - GOES Timer Error
TAN(***Num***)	Tangent of ***Num*** in degrees.

Function Syntax	Description
TIME ex: (display the time in HH:MM:SS) 10 a=Time Mod 86400 20 h=Int(a/3600) 30 m=Int(a mod 3600 / 60) 40 s = Int(a mod 60) 50 ? h!2!0;":";m!2!0;":";s!2!0	The current time in seconds since Jan 1, 1985 with resolution to the hundredth of a second. There are 86400 seconds in a day. There are 3600 seconds in an hour. You can calculate the start time of the current day with : Time - Time Mod 86400. You can then add or subtract seconds from this number to calculate absolute times.
TIMEOUT	Used to detect whether a device timeout has occured and can be used in conjunction with the WAITFOR and INPUT functions to tell whether input was terminated because of a timeout. TIMEOUT returns -1 (or true), when a timeout has occured on a device, otherwise 0 (or false) is returned.

Development Cycle

For all but the shortest programs, it makes the most sense to write the programs on a PC using your favorite editor and then upload the programs to the 8200. Then as changes are made to the program there are two approaches:

- make the changes in the 8200 and download the code to the PC
- make the changes in the code on the PC and upload to the 8200.

We recommend that you use the second approach because it insures that your final, debugged code is on the PC for future use. Using the first approach, you will sometimes forget to download the code to the PC and you will not have a copy of the final code.

Debugging/Troubleshooting

The following is a list of error messages you may see when running your program, or when using the inspect system display status option. If the command was not entered in immediate mode, you will also see the line number at which the error occurred in the program.

Error Message Description

Syntax Error	This is the most common error and it is issued when BASIC does not recognize or cannot execute an instruction. A divide by 0 will result in a syntax error.
Math Error	Math error is not currently used.
Sensor Not Found	A sensor name or variable was used which does not exist. Basic programs often use general purpose names for sensors (for instance Stage) which have no conterpart in the system setup enable sensors menu. The person setting up the unit is expected to decide which physical connection the sensor is connected to and then rename it to the logical name used in the Basic program (change Encoder1 to Stage).
Line Number Not Found	A branch to a line number occurred which does not exist in the program.
Sensor Not Logged	An attempt was made to access or log a sensor which is not contained in the log. The sensor may be enabled for logging, but may not yet be in the log if recording was never enabled. This is likely to occur after downloading a new setup and program, and running the program before the log has been initialized.
Max MEM() Exceeded	An access was made beyond the end of the MEM() array. Indexes to MEM() must be between zero and FREEMEM-1.

Device Already Open	An attempt was made to open the current device, i.e. interactively running a program on the RS-232 port which tries open the TERM: port.

One important debugging technique is to run your program interactively from within the Basic Interpreter itself. If your program logs sensors, make sure that you initialize the log first or you will get Sensor Not Logged errors as explained above. Try to put your program in to as many situations as possible. If you have multiple states make sure you try them all out. You may not realize that your program has a syntax error or logic problem until some later time when that code actually runs (which may be too late if that piece of code was the section which is supposed to detect a flood).

Once your program is installed and running as scheduled, you should check the Inspect System Display Status regularly to check on the Basic Status. Not only will this option report any errors which may have occurred (and line number), but it will also tell you what line the program is currently executing. This is an excellent way to check on whether your program is either spending too much time in a certain section or worse never reaching a section that is supposed to run. You will want to use the PC to display the status inasmuch as it can be displayed and refreshed quickly, giving you a real-time view of what the program is doing.

Chapter 11

Maintenance and Service

This chapter gives information needed to maintain and service an 8200. Its topics include general site maintenance instructions, 8200 assembly and disassembly, fuses, jumpers, initializations and resets.

This maintenance section describes the inspections and tests that should be performed on a working station to insure its continued reliable operation. If all the proper guidelines were followed when installing the site, maintenance should be quick and needed once a year. Included are checks of the enclosure, sensors, cabling, battery, antenna and 8200 itself.

Enclosure

Visually check the environmental enclosure and look for signs of moisture entering in. In some cases the enclosures "sweat" which does not cause great problems with the 8200 since it has a protective box surrounding the boards and the boards themselves are conformally coated. If a leak is discovered in the enclosure, it should be sealed. At locations where there is very high humidity, desiccant bags may be put inside the enclosure to absorb excess moisture. Desiccant bags do loose their ability to absorb water over time so they should be replaced at each maintenance visit.

Sensors

Check the accuracy of the value the 8200 has measured for each sensor. If possible, take with you a calibrated instrument for making an independent reading. Note that measurements such as temperature vary significantly depending on where the sensor is placed.

Check all the sensors for signs of wear and tear. If shaft encoders are used, make sure the shaft spins freely with no signs of binding or wobbling. For wind speed/ direction sensors, make sure it is able to rotate 360 degrees and the prop spins freely without binding. Tipping buckets should be checked for anything which may clog up the funneling mechanism and obstruct water flow into the buckets. Manually tip the mechanism 10 or so times and verify the 8200 counts the correct number of tips. If not, the mercury switch may need adjustment.

Cabling

Inspect the ends of the cables coming from the sensors. If they were tinned properly, they should not need servicing. If they were not tinned, they may be starting to fray in which case the ends should be cut, restripped, and properly tinned. It is very important to maintain good, clean connections between the 8200 and the sensors being used.

Battery

If external batteries are being used, there may be an in-line fuse between the battery and the 8200. Many users have mentioned that oxidation on the fuse holder itself is a cause of many intermittent failures. Just as dirty battery terminals in your car will cause it to not start, the same holds true when the 8200 tries to transmit. Therefore the terminals on the battery should be cleaned in addition to the terminals in the fuse holder.

In conjunction with dirty terminals causing battery related problems is the problem experienced with most batteries and their inherent designs. The types of batteries that are commonly used at DCP sites are Marine deep cycle or the standard type used in most cars. When the manufacturers of these batteries designed them, they relied on the assumption that they would always be located in a car, boat, or other moving object which would be constantly vibrating somehow. This constant vibration keeps particles in the electrolyte suspended not allowing them to fall to the bottom and bridge between the plates thus shorting the battery internally. Therefore, each time the site is visited, it is good practice to pick up and shake the battery for a couple of minutes thus extending the life of it considerably.

To test the battery to make sure it is good, you must measure the battery voltage while under a load. If you have an 8200 with a GOES transmitter, you can measure the voltage during a transmission. For other systems, you will want to at a minimum turn on the 8200 displays and set the brightness to full. If the battery is charged, the voltage should not drop any more than 0.5 volts when current is being drawn by the system. If the drop is more than this, the battery is not fully charged and may be defective.

Antenna and Cable

Check the antenna cable making sure the ends are securely fastened. Since the ends are handled most frequently, they are the main source of problems with the cable. Make sure there is sufficient weather proof tape coating the ends not allowing water to find it's way to the connections.

Inspect the positioning of the GOES antenna and reposition if necessary. Sometimes high winds or large birds roosting can cause them to be moved thus lowering the signal level going to the satellite. Make sure there is no corrosion or other foreign material on the outside of the antenna since any material on it could cause reflected power and further signal loss.

8200 Status

A very useful feature of the 8200 is the "Inspect System" main menu then to the "Display Status" sub menu. This screen is a tool to aid in determining if anything undesirable has happened to the 8200 since the last time the site was visited. There should be no error messages recorded, Recordings should read "Waiting..." (unless a measurement is currently being taken), the fail-safe is not tripped, and the schedules displayed agree with what is supposed to happen next. If error messages do appear, consult the Troubleshooting section of this manual for the appropriate steps to be taken to correct the failure. If the errors have been identified and their solutions determined, erase the error messages by going to the Clear Status sub menu and depressing the SET key then immediately to the Perform Selftest sub menu and depress the SET key. To verify the error messages have been erased, simply perform a Display Status again and view the screen. All the messages displayed should be normal and the unit be ready to be put back in operation.

You should record the Number of Resets value that is displayed and compare it to the value recorded the last time the site was visited. If this number changes it indicates the station has been reset.

Disassembly/Reassembly 8210

The 8210 package requires no disassembly to examine internal components. To access the inside of the 8210, simply loosen the thumb screws on the right of the front panel. The front panel will then swing clear, providing access to internal boards and cables.

Disassembly/Reassembly 8200A

The following steps can be followed to disassemble an 8200A.

1. Remove all cabling and grounding from the front panel of the 8200A.

2. Use the Hex wrench to remove the four bolts at the corners of the front panel.

3. Use the handles on the front panel and pull the front panel and electronics from the enclosure. Note that the front panel gasket may be attached tightly to both the panel and enclosure. Use a large screwdriver to break the seal if the front panel appears stuck.

> Caution: remove the electronics slowly. Do not allow parts to bump against the opening of the enclosure. If there is an internal battery in the 8200A, the electronics will be heavy and powered up!

4. Set the front panel/electronics on the table with the front panel in a vertical position. The electronics will tip over easily if it is placed on end.

To re-assemble the 8200A follow these steps:

1. Place the enclosure on a table top with the opening up and feet towards you.

2. Hold the front panel by the handles and lower into the enclosure. Make sure the panel is in its proper orientation. Do not allow electronic parts to hit the opening of the enclosure when inserting the electronics.

3. When the electronics tray reaches the bottom of the enclosure, it will need to line up with three guide/support pins. If the front panel does not sit flush on the enclosure, it will be because the tray is hitting one of these guide pins. Hold the front panel by the handles to lift it off the guide pins and move it slightly before lowering it again. Several tries are needed to get the pins to engage properly.

4. Insert and tighten the four bolts to hold the front panel in place. Make sure you use washers under the head of the bolt. The washer will often remain on the front panel. Do not over tighten the bolts.

5. Reconnect the sensor and power cabling.

Fuses

There are several fuses inside the 8210. The following table lists all the fuses for the 8210. Fuses designated RVx are thermal fuses and are automatically reset when the excess load is removed.

Module/Location	Designation	Rating	Function
Protection/ Termination Board 6461-1171 or 6461-1175	F1	1amp, 3AG	+12V to CPU board
	RV1, RV3	60ma	RS485 protection
	RV2	0.45 amp	SDI-12 port +12V
CPU Module 8210 6461-1170	RV1	0.66 amp	J1, pin 1, Aux +12 protection
	RV2	0.66 amp	Switched 12V protection
Cable to GOES tx	in cable	5amp, 3AG	+12 to transmitter
LOS Radio Module	in cable	2amp, 3AG	+12 to transmitter

There are several fuses inside the 8200A. The following table lists all the fuses for all the 8200A.

Module/Location	Designation	Rating	Function
Front Panel with two fuses 6461-1088-1 or 2 Rev E or later	F1	5amp, 3AG	Voltage to Battery
	F2	2amp, 3AG	+12V to SDI, CPU and Option Card
CPU Module 8200A 6461-1095-3	--	--no fuse--	--
Cable to GOES tx	none	5amp, 3AG	+12 to transmitter
LOS Radio Module	none	2amp, 3AG	+12 to transmitter

Multiple Module Support

When configuring the 8210 for multiple communications, follow these examples:

SLOT1	SLOT2	REASON
GOES	RADIO	GOES only works in slot 1
GOES	SPEECH	GOES only works in slot 1
RADIO	RADIO	Dual radios are supported, dual GOES or SPEECH are not.
RADIO	SPEECH	Other order might cause the radio to miss messages
SPEECH	INT-MODEM	May occasionally miss a wakeup

As a rule of thumb: GOES always goes in SLOT1, SPEECH always goes in SLOT2. Be sure to set the switches on the CPU board to indicate the type of communications board installed.

Jumpers and Connectors 8210

CPU Module Switches
Option Board Definition Switch

SW1	SW2	Slot 1 -- J4
C	C	LOS Radio
C	O	Speech Modem
O	C	GOES
O	O	None

SW3	SW4	Slot 2 -- J5, J3 Internal Comm
C	C	LOS Radio (J5)/External Radio (J3)
C	O	Speech Modem (J5)
O	C	External Modem or Terminal (J3)
O	O	None

O=OPEN, C=CLOSE

CPU Module Jumpers

Jumper	Position	Description
J7	ON	Reset System
J7	OFF	Normal Run
J8	+5V	VPP for Flash EPROMS
J8	GND	GND for Flash EPROMS
J9	NORMAL	SDI-12
J9	SLAVE	SDI-12
J10	ON	RS485 Termination
J10	OFF	RS485 Termination
J12	ON	Watchdog Enable
J12	OFF	Watchdog Disabled
J14	A6	Analog/Pres 6 connect to A6

Jumper	Position	Description
J14	-DIFFIN	Analog/Pres 6 connect to -DIFFIN
J15	A7	Analog/Pres 7 connect to A7
J15	+DIFFIN	Analog/Pres 6 connect to +DIFFIN
J16	ZNR	Alternate Memory Disable
J16	PS	Standard Memory Disable
J17	ON	Differential sense for Pressure Port Enabled
J17	OFF	Differential sense for Pressure Port Disabled
J18	ON	PCMCIA Bootstrap enable
J18	OFF	PCMCIA Bootstrap disabled
J19	A5	Analog/Pres 5 connect to A5
J19	-5VDIFF	Analog/Pres 5 connect to -5VDIFF
J20	A8	Analog/Pres 8 connect to A8
J20	+5VDIFF	Analog/Pres 8 connect to +5VDIFF
J21	ENABLE	Enable Battery to RAM and clock
J21	DISABLE	Disable Battery to RAM and clock

Default Jumper position

Protection/Termination Module Jumpers

Jumper	Position	Description
J7	J7, 1-2	Charger high current mode, allows charger to output full current with a normal or missing battery. Allows unit to operate without battery however, high current transmissions will cause the unit to reset.
J7	J7, 2-3	Normal charger mode, limits charger current when battery has a low terminal voltage (from a shorted cell) preventing overheating conditions.

Default Jumper position

CPU Module Connectors

Connector	Purpose	Pin Number	Description
J1	Aux. +12 V DC	1	+12 V
		2	Gnd
J2	Opto-22 Interface Connector	1,49	+5 Volt
		2,4,6,....50	GND
		3,5,7	No Connection
		47	(P00) I/O Module 0
		45	(P01) I/O Module 1
		43	(P02) I/O Module 2
		41	(P03) I/O Module 3
		39	(P04) I/O Module 4
		37	(P05) I/O Module 5
		35	(P06) I/O Module 6
		33	(P07) I/O Module 7
		31	(P10) I/O Module 8
		29	(P11) I/O Module 9
		27	(P12) I/O Module 10
		25	(P13) I/O Module 11
		23	(P14) I/O Module 12
		21	(P15) I/O Module 13
		19	(P16) I/O Module 14
		17	(P17) I/O Module 15
		15	(P20) I/O Module 16
		13	(P21) I/O Module 17
		11	(P22) I/O Module 18
		9	(P23) I/O Module 19
J3	Internal COM Port DB-9 Female (RS-232 Sense) (CMOS Levels)	1	DCD
		2	RXD
		3	TXD
		4	DTR
		5	GND
		6	NC
		7	RTS
		8	CTS
		9	NC
J4	Ribbon Cable to Option Board SLOT 1	1-30	GOES Transmitter, LOS radio modems, speech and telephone modems, etc.
J5	Ribbon Cable to Option Board SLOT 2	1-30	LOS radio modems, speech and telephone modems, etc.
J6	Spare Front Panel Connector (No Connector installed)	1	Common1 (Gnd)
		2	Left Arrow
		3	Up Arrow
		4	Down Arrow
		5	Right Arrow

Connector	Purpose	Pin Number	Description
		6	Set
		7	On Off
J11	Ribbon Cable to Protection/ Termination Board	1-50	All power lines and all signal lines.
J13	Test Points (No Connector installed)	1	uTXD0
		2	uRXD0
		3	uCTS0*
		4	uRTS0
		5	UART0 ON
		6	GND
		7	+5 Volts
		8	+12 Volts
		9	-12 Volts

Protection/Termination Connectors

Connector	Purpose	Pin Number	Description
J1	Sensor/Signal Ribbon Cable	1-24	Digital outs, phone, counters, swd power
J2	Sensor/Signal Ribbon Cable	1-26	analogs,SDI,RS232
J3	2-Pos Moles Power Connection for option card	1 2	+12 V Gnd
J4	2-Pos Moles Power Connection for option card	1 2	+12 V Gnd
J5	2-Pos Molex Telephone Connection	1 2	+12 V Gnd
J6	2-Pos Molex Internal Battery Connection	1 2	+12 V Gnd

Refer to drawings in Appendix C for the locations of connectors.

Jumpers 8200A

Front Panel Jumpers

Rev 6461-1088-1 or 2 Rev E or later

Jumper	Position	Function
J7	ON	Charger Bypass
J7	OFF	Charger In line

Default Jumper position

CPU board for 8200-xx14 (8200A)

6461-1095-3

Jumper	Position	Function
J1	1-2	Battery OFF
J1	2-3	Battery ON
J2	ON	Watchdog enable
J11	1-2	Press1 to -5V
J11	2-3	Press1 to A5
J12	1-2	Press4 to +5V
J12	2-3	Press4 to A8
J13	1-2	Press3 to -DIFF
J13		Press3 to A6
J14	1-2	Press4 to +5V
J14	2-3	Press4 to A7

Default Jumper position

Satellite Module Jumpers

There are no jumpers on the Satellite radio module.

Satellite Module Failsafe Reset

NOAA-NESDIS requires that all GOES transmitters be equipped with fail-safe circuitry. The fail-safe circuitry is designed to prevent transmitters from jamming a channel. The fail-safe limits both the length of transmissions and the time between consecutive transmissions.

The fail-safe circuit is reset from either the front panel, PC or by a push-button on the GOES transmitter card. To reset the failsafe from the front panel or PC you must go to the Main Menu\Recording field. If this field includes FT the fail-safe is tripped. To reset the fail-safe, press SET (front panel) or R (PC) several times until the FT is deleted. Normally this happens when the status is OFF&FT and the status becomes OFF.

You do not need to use the hardware reset if you have already reset the fail-safe from the front panel or PC. However, if you want to use the hardware reset button, it is located on the GOES card, next to the large crystal oscillator. On the 8200A, this push-button can be accessed through a plug on the side of the 8200. The fail-safe button is immediately behind the type "N" connector on the front panel used for connecting the GOES antenna lead. Push the button momentarily to reset the circuit.

NOTE: Main battery power must be applied before resetting the fail-safe or the operation will have no effect.

Radio Module Jumpers

Refer to the separate manual on the 8200 LOS Radio module for jumper settings.

Telephone Module Jumpers

Modem standard (Bell or CCITT)
The modem standard is determined by the setting of switch 1 of S1 on the modem option card. Set the switch according to Table.

SETTING THE MODEM STANDARD

Switch 1 of S1 Standard	Typical Usage	Setting
Bell	USA	Open*
CCITT	(most other countries)	Closed

*Factory default setting

Pulse dial modes
The pulse dial mode (make/break ratio) is determined by switch 2 of S1 on the modem option card.

SETTING THE PULSE DIAL MAKE/SPACE RATIO

Switch 2 of S1 Make/Space Ratio	Typical Usage	Setting
40/60	USA	Open*
33/67	(most other countries)	Closed

*Factory default setting

Setting the speaker mode

The 8200 modem options include an audio amplifier and speaker connections for audible verification of modem operation. The speaker is connected to J1, using shielded cable (pins 1 and 3 are ground, pin 2 is the audio signal). The volume is controlled by R15.

Set the speaker mode by placing a jumper between the two pins of J2, J3, or J4, as described below:

Speaker on: J2

In this mode, the audio on the telephone line will always be broadcast by the speaker. This option is most useful in voice only applications.

Auto speaker switching: J3

In this mode, the speaker will automatically turn off when the telephone modem establishes communications with another modem. The speaker will continuously remain on during speech operations. This is the factory default setting.

Speaker turn-off: J4

In this mode, the speaker will automatically turn off when the telephone modem establishes communications with another modem or "times out". The speaker may be turned off during speech operations. This mode is usually used only in modem-only (no speech) applications.

Initialization and Resets

There are several different initialization and reset functions. The following table explains the function and use of each:

Initialization	Clears out a setup and sets the EEROM to default values, resizes the RAM. Clears out a setup and sets the EEROM to default values, resizes the RAM"
Password Reset	Clears out the password for the setup. Used when the password has been forgotten.
Hard Reset	Causes the microprocessor to restart. The 8200 will continue to use the setup in RAM if it is valid. Otherwise, the setup will be restored from EEROM.

Initialization

To initialize EEROM and RAM to factory settings perform the following steps:
1. Power off the 8200
2. Push in the left and right arrow keys simultaneously.
3. Reconnect the battery while holding down the keys.

(note: on models with an internal battery and no switch, you will need to remove the 8200 from its case to disconnect the battery)

Password Reset

To reset the password on a system to "", perform the following steps:
1. Power off the 8200
2. Push in the down arrow key and while holding the key
3. Reconnect the battery while holding down the key

(note: on models with an internal battery and no switch, you will need to remove the 8200 from its case to disconnect the battery)

Hard Reset

A hard reset is a restart of the microprocessor. To perform a hard reset, press all four arrow keys at the same time.

Chapter 12

Troubleshooting

This chapter gives instructions on how to troubleshoot an 8200. You will want to review this chapter to learn better how the 8200 operates as well as service a site that may have a problem.

Introduction

The 8200 was designed for rugged field operation in extreme conditions. We have done our best to provide you with a reliable data logger. In the event you have trouble with the 8200, we recommend that you first look for the cause in the most obvious of places. Many common problems come from simple sources. Corroded or damp connectors probably cause 95 percent of all problems, followed by old, failing batteries and improper setup.

General Troubleshooting Procedures

Troubleshooting should always follow a logical progression. The intent should always be to isolate the problem to a specific area, and then focus on that troubled area. Is it an instrument problem? Is it a power problem? Is the unit set up properly? The following paragraphs describe how to isolate problems.

Display will not light

The display should light when power is first applied to the 8200 or when ON/OFF is pressed. The exception is when TINY-BASIC is in control of the display and has it turned off for some reason. If the display does not light as explained, the first suspects should a dead main battery or a fuse.

To check an external battery, simply measure the voltage on the battery using a Volt Meter. To check an internal battery, you must first open the unit in order to reach the battery.

If the battery voltage is less than 9.5v then the battery is either discharged or faulty and must be replaced or recharged. A normal battery will read 11 to 13 VDC without charging and 13 to 14.7 volts under a charge. Disconnect the charging voltage if it is present to get a good measure of the batteries condition.

If the battery is in good condition, you should next check the condition of the fuses. The unit must be open to check the fuses. The 8210 has a single fuse on the protection/termination board as a back up to its thermal fuses. The 8200A has two fuses located on the front panel board. If the a appears to be blown (broken wire or black coating inside fuse) then replace it. If it appears to be good, pry it out and check it with a volt/ohm meter.

Blown fuses are normally a sign of shorts in sensor or charging circuit leads. If you replace a fuse, disconnect all of the wiring from the terminal block plugs, replace the plugs, and then connect the instruments one at a time with the display on. If the fuse blows again during this operation you will know which sensor is at fault. Similar reasoning applies to an external charger or power supply.

If the 8200 will not power up after you have checked and/or replaced the battery and fuses, then you may have a serious problem and the unit must be returned to the factory for repair.

8200 turns on but does not work properly

When the 8200 display will come on, but you still have problems then you must determine whether you have a hardware problem or a software setup problem. Hardware problems occur when sensors quit, wires become loose or corroded, or things are wired incorrectly. Setup problems are those in which signals get to the 8200 but are not properly sampled, processed, or recorded.

Sensor problems

Hardware problems may show up in several ways. Two of the most common ways are; (1) inability to obtain sensor data at a new installation; and, (2) data for one or more sensors disappears at a site that has been working properly.

The first place to begin diagnosing a sensor hardware problem is the 8200 unit. Turn the 8200 display on and use the arrow keys to move to the VIEW DATA - LIVE READINGS sub-menu (Refer to Figure 2-2). Move into the LIVE READINGS sub-menu and use the up/down arrow keys to display each sensor and check to see if each is providing a reading. For sensors that require switched 12 volts, check that the SYSTEM SETUP\MEASMNT SCHEDULE\PwrMode is set to ON.

After you have the live readings for the sensor on the display, logically work in an outward direction from the 8200 to the sensor. Here are some of the questions you should ask:

- ☑ Are the sensor wires properly connected to the terminal block? (Correct polarity? Screws tight?)
- ☑ Are the wires from the terminal block to the sensor OK?
- ☑ Is there a connector at the sensor end?
- ☑ If there is, is it solid? Is there moisture in it?
- ☑ If this is an analog sensor, can I measure a voltage output at the terminal block? At the sensor end?
- ☑ If this is a switch closure device can I see the switch closure at the terminal block end with the wires disconnected?
- ☑ If I simulate the input (for example, hook up a known voltage across an analog input, or hook a switch across a counter) does the live reading value change properly?
- ☑ Is the 8200 drawing excessive current. Use an ammeter inline with the +12VDC positive lead to measure the current. Excessive current may be caused by a faulty sensor or wiring.

In most cases, if you can simulate the input, you should. This will ensure that the 8200 is operating properly. If you cannot get live readings off a sensor after checking the terminal block connection, the wires, and any sensor-end connector, then you probably have a sensor failure.

If you can measure output at the instrument but have no live readings then you probably have a corroded or loose connector or broken wire. Improper wiring should also be considered (polarity reversed).

If you are certain that signal is reaching the 8200 but the live readings are zero, then you may have a setup problem. Read the next section on diagnosing setup problems.

Setup Problems

Setup problems may also show up in several ways. Some of the ways include:

- data is not recorded on any sensor;
- data is not recorded from one or two of several sensors;
- all recorded data is zero or some incorrect value for a sensor; recording cycles are skipped.

If no data is recorded, there are two likely setup problems. First, for data to be recorded (logged) you must have Log turned ON in the CONFIGURE SENSORS sub-menu entry for the sensor. Second, Recording must be ON in the main menu. If Recording is OFF then no data will be recorded for any sensor. If Log is OFF for any sensor, then that sensor will not be recorded (For more CONFIG SENSORS information, turn to Chapter 4, page 4-67).

If recorded values for a sensor are all zero or some incorrect value, even when you know the input levels are correct, then you are probably misusing the SLOPE and OFFSET in the CONFIGURE SENSORS sub-menu. Values are Logged (recorded) according to the formula:

(Recorded Value) = [(Raw Value) * SLOPE] + OFFSET

When you use the LIVE READINGS sub-menu you are looking at the Recorded Value from this formula. If you have accidentally entered the SLOPE as zero you will get zero for all readings. If you have a sensor which does not change much and you enter a negative offset equal to the mean reading you will get zero or very small negative and positive values in the log (For more on LIVE READINGS, see 4-80).

If the 8200 appears to be skipping recording cycles then the problem is probably in the setup of the MEASUREMENT SCHEDULE sub-menu. When you develop a schedule you must remember that one complete processing cycle should complete before another begins. That is, the 8200 must be able to turn on power, collect all samples for averages, take individual measurements, log measurements and averages, and turn off power before starting over. If you specify a Measurement Interval which is less than #Samples/Set times SampInt then you may cause cycle skipping (For more on MEASUREMENT SCHEDULE, see 4-73).

LOS Radio Communications Problems

LOS radio communications problems are difficult to solve because of the number of factors that can cause problems. This list includes:

- ☑ setup errors
- ☑ radio frequency off
- ☑ radio transmitter deviation too high/low
- ☑ radio/modem mismatch
- ☑ antenna/cable problems
- ☑ path problems
- ☑ interference problems.

The place to start to troubleshoot radios is the 8200 itself. The 8200 maintains communications statistics giving the number of messages received and transmitted and the number of failures. A typical report will be:

Radio: RX 155/541, 15 bad TX: 155, 10 bad

The first number following RX (the 155 in the example) is the number of messages the 8200 received that were directed to its UnitID. If this number is 0, the 8200 has not received any messages with its UnitID. The second number (541) gives the total number of messages received. This count includes messages that were addressed to other stations. The third number gives the number of messages that were received, but had errors indicating a corruption of the message. The numbers following TX give the number of transmissions that succeeded, number of attempts and the number bad.

When you have communications problems you should note these numbers and decide what they tell you about the problem. Sometimes the answer will be clear just by looking at these values.

Also use the Inspect System\Monitor Communications function. Using this function you will be able to see what the 8200 is receiving and transmitting. This will sometimes help you to identify problems in the setup or help you identify the problem more clearly.

However, more often than not you will need to clear the status and then conduct a test of each path to see if it is working.

Here are some general steps to follow when debugging a radio setup.

1. If you can have a person at site 2 while another is at site 1, try some simple tests shown in steps 2 to 7. Otherwise skip to test 8.
2. Key the transmitter at site 1, verify that carrier is detected at site 2.
3. While the transmitter is keyed send some test characters, verify that the characters are received at site 2.
4. Unkey the transmitter at site 1, and make sure carrier detect drops at site 2.
5. Key the transmitter at site 2, verify that carrier is detected at site 1.
6. While the transmitter is keyed send some test characters, verify that the characters are received at site 1.
7. Unkey the transmitter at site 2, and make sure carrier detect drops at site 1.
8. At site 1, use the M-Monitor Communications\Send [T]o command to set a destination for communications (using PC) or make sure that the PROTOCOL SETUP/Master: is set to the name of site 2 which you are talking to.
9. Try sending a test mail message from site 1 to site 2, you will receive either the message "Mail Delivered." if an acknowledgment was received or "Mail Failed." if an acknowledgment was not received.

10. Try the same test at site 2 if possible.
11. At site 1, use the BERT menu to get a detailed view of how well communications are working. Again, be sure to first use the Send [T]o command (M-Monitor Communications menu) or PROTOCOL SETUP/Master (front panel) to set the destination).
12. First use the [R]emote Clear command to clear the BERT statistics at site 2. Then use the [S]end Bert from site 1 to send a BERT message to site 2 (and all stations in radio range).
13. Use the [G]et Status to get the BERT status from station 2. This status represents how well station 2 is receiving station 1.
14. At station 1, use the [L]ocal Clear to clear the BERT statistics. Then use [A]sk for Bert, to have station 2 send station 1 a BERT message. The local statistics will show how well station 1 is receiving station 2.
15. If you cannot get steps 1 through 13 to function reliably then the rest of your radio system will not work. Be sure to set the PROTOCOL SETUP/Master: field to the name of your master station when you are finished if you changed it.

If you are using a PC you will be able to do the above tests using the INSPECT SYSTEM\M-Monitor Communications Menu. This menu allows you to display the status of carrier detect, key/unkey the transmitter, select a destination for transmissions, view BERT information, view mail information and more. For a complete description of this menu, refer to the information on page 4-36.

If you are testing without a PC, you can use the Front Panel INSPECT SYSTEM\Test LOS Radio command. Before doing so you may need to use the INSPECT SYSTEM\Select Radio command to select between a radio in slot 1, slot 2 or external radio modem.

Troubleshooting Guide

The following table lists a variety of problems which may occur with an 8200 along with the likely cause/solution.

PROBLEM	PROBABLE CAUSE/CORRECTION
Display will not light	8200A ON/OFF switch in OFF position. Remove switch cover and press switch. 8210, battery disconnected. Open unit and connect battery cable to J6. Battery discharged or worn out, open unit and check battery voltage. External charging circuit faulty. System may be resetting which can take several minutes - see System Resets. Fuse Blown - open unit and check the fuses.

PROBLEM	PROBABLE CAUSE/CORRECTION
Unit will not record data	Recording is OFF in main menu - turn Recording ON.
No recorded data for one sensor	Log is OFF for sensor - go to CONFIGURE SENSORS sub-menu and turn on Log for missing sensor.
All sensor data recorded as zero	SLOPE set to zero in CONFIGURE SENSORS sub-menu - go to sub-menu and set slope to correct value. Use 1.0 if sensor reads out in user units. Possible hardware problem - go to LIVE READINGS sub-menu and see if data are reaching 8200 - if not, perform hardware diagnosis on wiring and sensor.
Excessive power usage	Power usage is a function of how many sensors are connected, how long they are turned on, and how often they are sampled. Minimize power consumption by sampling as infrequently as possible, turning on the +12v power only when needed, and keep the Measurement Interval as long as possible. Disconnect the sensors to see if one of them is causing excessive power drain. Do not leave the display on for long periods - the red LED's use considerable power.
8200 looses clock time or setup when main battery is changed	Make sure the on-board RAM battery is >2.6 volts. Battery jumper on the RAM backup battery is in the OFF position.
Unable to transfer a setup from a RAM Card	RAM Card battery low. Check battery.
Battery slowly discharges even with external charger	The external power connection on the terminal block is fused. If the fuse blows then the battery will not recharge. Check the fuse. Check the power consumption of the 8200 and sensors.
Display is too dim	To change the display brightness, press the [set] key when the display is at the top of the MAIN menu (Sutron 8210 xxvv).

PROBLEM	PROBABLE CAUSE/CORRECTION
Averages are not computed	Make sure you have not turned on both Measure and Average for the sensor. Because of the way the 8200 handles scheduling Measure has precedence over averaging when data are Logged. Measure and Average are mutually exclusive. If you are using the WindSpeed and WindDir sensors make sure that inputs are wired correctly and that SLOPE and OFFSET are correct for both the speed and direction sensors.
Pressure transducer gives incorrect or no readings	Make sure jumper J8 is in the correct position (8200A)
SDI-12 Sensors do not operate	SDI-12 device set to wrong address. Use commands to query address or set to new address. Incorrect wiring or wiring short. Check wiring. Fuse blown (8200A). Check fuse.
8200 will not communicate with another Sutron device	Check the baud rate in the EEROM SETUP sub-menu. Make sure Serial field in EEROM SETUP sub-menu is set to PROTOCOL (Toggle with the key). Check cable wiring. Make sure RS-232/TTL jumper on main circuit board is in correct position. Check other jumper settings.
RAM Card missing last day of data	The 8200 does not dump "today" to the RAM Card. If you want today's data on the RAM Card you must reset the Date field in the MAIN menu to fool the software. .
System runs for a short time and then resets	Pressure sensor enabled with no sensor connected to terminal block Possible low battery voltage If problem persists, return unit to factory.
Live readings OK but nos. in log clipped off at multiples of 32767 (e.g. 3.2767 or 32.767)	Incorrect setting of Right Digits - See Chapter 4.

PROBLEM	PROBABLE CAUSE/CORRECTION
Telephone-equipped unit will not answer phone	Bad connection to telephone line Ring signal not present on line Improper settings of jumpers/switches, see Chapter 11 for correct settings.
Cannot transfer data from telephone-equipped unit	Check baud rate setting
GOES unit transmits at incorrect time	Make sure time is set to correct. Universal Coordinated Time (GMT). Make sure that transmit time is entered properly
GOES unit will not transmit	Check forward power of the transmitter at the antenna. Check back at the 8200 itself if there is no or low power at the antenna. Make sure the antenna cable is OK. Remember that you must have enabled sensors using the Alarm OPTIONS sub menu and entered GROUP information in order for the 8200 to transmit. Also check to make sure you have entered TX Rate. Check the battery connection. Make sure it is made to the external battery input and not the solar panel input. Check the battery voltage during a transmission. The voltage should not drop more than 0.5 volts during the transmission. Make sure the voltage is greater than 10.5 and less than 14.9 volts. The 8200 will not make a transmission if the voltage is outside these limits. Make sure fail-safe has not tripped - use System Status - display status to check or look at recording status. To reset the failsafe using the front panel, go to Recording Status and press SET until FT goes away. To reset the failsafe using a PC, go to Recording Status and press R until FT goes away. You can also reset the failsafe using the hardware reset button located on the GOES transmitter. This can be accessed by removing the plug in the bottom of the 8200A (8200A) or opening the front panel to expose the satellite transmission module (8210).

SDI-12 Interface Standard

SDI 12 is recent standard for interfacing to smart serial sensors. SDI allows you to connect up to 10 sensors with as many as many as 9 parameters each. The interface is implemented using three wires: Data, Ground, +12V.

Grounding

The ground conductor of the SDI interface line should be large enough to keep the voltage drop between the data recorder and the sensor to less than 0.5 volts during the maximum sensor current drain. Failure to observe this specification will cause bad communications and/or bad data.

Connector type

The connector type is not part of the SDI specification. On the 8210, there are two interconnected sets of SDI-12 connections. The 8200A uses a DB-9 labeled SDI-12 with the following pinouts: 1-Data, 7-Ground, 9-+12V.

Communications

Communications rate is 1200 baud, ASCII printable characters or Data can be viewed on most terminals, though not all (some terminals will not read SDI because the standard does not make use of (-) voltages). In order to view SDI data, connect the data line to the RX data line of the receiving device. This will normally be pin 3 for DB-25 inputs on terminals and IBM PC's or compatibles. For PC-AT's or laptop PC's this will normally be pin 2 of the DB-9 connectors. Ground must also be connected most likely to pin 7 on DB-25, pin 5 of a DB-9.

SETUP of SDI sensors

Each SDI-12 sensor has an address from 0 to 9. This address differentiates one sensor from another. As they are shipped, they are almost always set to address zero (0). If/when you are interfacing more than one sensor to the 8200 you must set each sensor to a unique address. This is normally done by setting dip switches on the sensor or by software commands via the front panel of the 8200 or the programming terminal being used. Failure to set unique addresses for each sensor will result in failure of the communications interface. i.e. no data logged. Consult the sensor manufacturers data for information on your particular sensor(s).

Issuing SDI commands

From the front panel go to the Inspect System menu - go down to enter SDI-12 command - press set - get ENTER: - use arrow keys to set the characters - the ! is done for you - press set when done. Result (reply from the sensor) will be displayed - press set to continue - From a terminal - go to same place in menu tree, type in the SDI command, here you have to enter the ! yourself.

Useful SDI commands

Resetting the address by software (some sensors) is normally done by sending the aAb! command. (a A b !, where a is the current address of the sensor you want to change and b is the address you want to change to, e.g. 0A5! changes the address of sensor 0 to address 5.)

Use the enter SDI-12 command option of the inspect system menu in the 8200 for the above operation (or any SDI 12 command operation). Other initialization may be required for your sensor, including calibration, sample interval, etc. You may be required to use the sensor manufacturer's test set for such operations.

Another useful SDI-12 command is the aI! (where a is the address of the sensor, e.g. 3I! for sensor at address 3) command. 4I! will return an identification string from the sensor at address 4 which includes the SDI version no., the vendor's name, and the sensor model #, sensor version #, and serial #. This is a quick way to see if the sensor is responding properly.

A way to verify data collection (manual data collection) is - issue the aM! command. For example 7M! would collect data from the sensor at address 7. The sensor will respond with a 5-digit code -- the first digit is the address, the next 3 digits are the required time for measurement in seconds, and the last digit is the no. of data values returned. Wait for the number of seconds. Then issue the aD0! (address, D, zero, !) the sensor should respond with one or more data values. You may issue further aD1! --- aDn! till you get all of the data. This is the same sequence the 8200 automates for you. If this doesn't work by hand the 8200 can't do it for you either!

CAUTION:

On the 8200A, don’t short the 12v line to a ground when working with bare wires- it is easy to do this but it blow the front panel fuse. Make the connection to the 8200 LAST -wire multiple sensors together first.
(The 8210 uses a thermal fuse to protect the 12v line so shorts do not blow a fuse)

Power Consumption

On the 8210, the 12V line is protected by a thermal fuse. If you short the 12V line, the thermal fuse will interrupt the power to the line. Power will be restored when the short is removed. On the 8200A, the 12V line is protected by a standard fuse. If you short the 12v to a ground (when working with bare wires it is easy to do this you will blow the front panel fuse. Make the connection to the 8200 LAST - wire multiple sensors together first - don't take chances with shorts! The entire system load when the SDI sensors are not communicating should be only a few milliamps per sensor. This will depend on the manufacturer of the sensors being used. You can measure the current flow through the +12 to check out the correct system operation. If the current draw is too high you will drain the system battery. Current draw under sample conditions will be much higher.

The maximum current used on the +12V line should not exceed 2 amps at any time.

Appendix A

8200 Specifications

8210 Data Recorder/Transmitter

8210-0014

SPECIFICATIONS - All models 8210

Dimensions	12”x10” x6” NEMA 4 enclosure, molded fiberglass polyester construction. With quick release latches. (Other enclosures available)
Weight	10 lb. Typ. without battery. (Options affect weight -- see Data Sheets for 8200 Options)
Temperatures	-40°C to +60°C Operating
Processor	NEC V25 plus 16 Bit Processor Clock speed 5 MHz (internal) Full real time multitasking capability provided.
Memory	RAM Battery backed up 122K (or 62,000 readings), Expandable to a total of 378K (or 190,000 Readings) in 128K Increments. EPROM 256K Operating System
Battery (Ram) Backup	Lithium Battery storage: 2 years min. (depending on environment)
(Data Storage)	Back up Life: 1 year min.
Internal Battery	(8200-0014-1 version only)
	6.5 Amp Hour, 12 Volt sealed battery
Real-Time Clock	Accuracy of 1 minute/month (8210-5014-1 GOES Satellite units accuracy 15.7 sec/yr with typical accuracy of 5 sec/yr)
Watchdog Timer	System Reset upon microprocessor failure
Sample Intervals	1 sec. to 24 hr. in 1 second increments. (dependent on memory and sensors)
Removable Memory Card Type	PCMCIA Format, Static Ram cartridge. Size up to 2 MB. See Sutron Supplied Options.
Data Retrieval	RS-232 Port or PCMCIA Memory Card Slot.
Visual Display	16 character alphanumeric LED
Serial Sensor	Connection through RS-232 port (One internal RS-232 port is available through Tiny Basic control. See manual for use of ports with dual communication configurations)
SDI-12	Fully supported through SDI-12 port. See RS-485 for option. Power to external sensors is polyfuse protected (no fuse replacement required).
RS-485	RS-485 compliant port capable of supporting SDI-12 protocol for long distance communication to compatible sensors. General access to the port is controlled by Tiny Basic.
Front Panel Access	System setup and control through the front panel. User security is controlled through use of password (setup option).
Communications	Any one or two of the following: Satellite Radio, LOS Radio, Telephone w/Modem and Speech Synthesis, cellular radio. (Note if the cellular radio is mounted internally to the 8210, the second internal communication slot is not available
Internal Power Supply	Internal Battery (-0014 and -3014 models only), 12V @ 6.5 aH, operates the 8210 for 90 days at 15 minute sampling.
Solar Panel Charger	Internal charger regulator provides 1.25 Amps max for solar panel input or DC voltage. Regulator utilizes different charge rates depending on the state of battery resulting in float charging the battery at 13.8 Vdc
Power Consumption	Quiescent: 270 uA Typ, 500 uA Mx TypAvg: 2 mA @ 15 - minute intervals of shaft encoder sample
Digital Inputs and Outputs	20 (internal to the enclosure) software controlled I/O lines with connector pinouts compatible with OPTO-22 interface equipment. 12 lines defined as inputs and 8 lines defined as open collector outputs. 5 of these outputs are provided to the outside of the 8210 enclosure. (see ECN 4607)
	Software Control of switched external 12VDC power. 12 VDC Power is polyfused. (No fuse replacement required)
Shaft Encoders	Switch closure w/quadrature inputs (2 quadrature S.E. max.)
Tipping Bucket Rain Gauges	Input Levels: 0-5V Switch closure 5 Max.
Counter Inputs	5 Max Resolution: 16 bits Max. Input Frequency: 32 kHz ± 0.1% w/o rollover, 1 MHz max. w/rollover
Analog Inputs	8 Standard (Not using differential port) Resolution: 13 bits Accuracy: ± 0.02% of full scale over temperature range Input Range: 0-5V Standard DC Excitation Output: +5V, +12V Pwr Consumption A/D: 30 mW active
Pressure Transducer	(Jumper-Selectable) Differential measurement (reduces standard analog inputs to 6 or 4 if excitation is used) DC Excitation: ±5V Interface Differential Input Range: -5V to +100 mV

8200A Data Recorder/Transmitter

8200-0014

SPECIFICATIONS -- All models 8200A

Dimensions	5 1/2" H x 10 1/4" W x 9 5/8" D (including handles)
Weight	7 lb. (Options affect weight -- see Data Sheets for 8200 Options)
Temperatures	-40°C to +50°C Operating
Processor	NEC V25 plus Clock speed 5 MHz
Memory	RAM 124K (or 62,000 readings), Expandable to a total of 380K (or 190,000 Readings) in 128K Increments. Battery backed up EPROM 256K Operating System
Battery Backup	Lithium Battery storage: 2 years min. (depending on environment) Back up Life: 1 year min.
Real-Time Clock	Accuracy of 1 minute/month (GOES units have greater accuracy)
Watchdog Timer	System Reset upon microprocessor failure
Sample Intervals	1 sec. to 24 hr. in 1 second increments
Data Retrieval	RS-232 Port RAM Pack (10 sec download time)
Visual Display	16 character alphanumeric LED
Serial Sensor	Connection through RS-232 port (Unit remains programmable through port)
SDI-12	Fully supported through SDI-12 port
Communications	Satellite Radio, LOS Radio, Telephone w/Modem and Speech Synthesis
Power Supply	Internal Battery (-0014 and -3014 models only), 6.5 aH @ 12V, operates 8200 for 90 days at 15 minute sampling. Internal charger regulator 0.75 amp max for solar panel input or DC voltage
Power Consumption	Quiescent: 500 uA Typical Avg: 2 mA @ 15 - minute intervals of shaft encoder sample
Control Output (1)	Software Control of switched 12VDC power (see ECN 4607)
Shaft Encoders	Switch closure w/quadrature inputs (2 max.) 3 wire + 12V (4 wire) interface to counters
Tipping Bucket Rain Gauges (5 max.)	Input Levels: 0-5V Switch closure
Counter Inputs(5 max.)	Resolution: 16 bits Max. Input Frequency: 32 kHz ± 0.1% w/o rollover, 1 mHz max. w/rollover
Analog Inputs	8 Standard Resolution: 13 bits Accuracy: ± 0.02% of full scale over temperature range Input Range: 0-5V Standard DC Excitation Output: +5V, +12V Pwr Consumption A/D: 30 mW active
Pressure Transducer	DC Excitation: ±5V Interface Differential Input Range: -5V to +100 mV

SPECIFICATIONS -- 8200-3000 Speech Modem Module

Dimensions	5 1/2" H x 10 1/4" W x 9 5/8" H
Weight	12 lb. (with internal battery)
Operating air temp range	-40°C to +60°C
Storage and shipping temp range	-55°C to +115°C
Electronics Specifications	Protected to 3000 Volt (peak), 500 Joule transient phone line surges from tip to ring, tip to ground, and ring to ground Receiver sensitivity -45dBm Receiver dynamic range 36dBm (-9dBm to -45dBm) Low power standby mode
Standard Interface	Telephone 2 wire to RJ-11 modular jack
Mode *Compatibility*	Full duplex over public switched telephone network (PSTN) Bell 212A (1200 bps) Bell 103 (300 bps) CCITT V.22 (1200 bps) and V.21 (300 bps)
Answer Mode Features	Ring detect Auto-baud rate detection 2225 Hz Answerback Tone 30 second timeout if baud rate training sequence not complete
Dial Mode Features	Dual-tone, multifrequency (DTMF) or pulse dialing 2225 Hz Answerback tone detection One minute timeout if AT not received Programmable number of call attempts after programmable delay
Test Modes	Digital loopback
On-Hook/Off-Hook Control With Call Termination	On-hook call termination after auto-answer or auto-dial timeout 30 seconds (programmable) of data inactivity system reset power-up initialization
Applicable Standards	Phone Line Interface meets or exceeds the following standards: U.S. Federal Communications Commission (FCC) Rules and Regulations Part 68 Canadian Department of Communications (DDC) Standard CS-03 Electronic Industries Association (EIA) Standard RS-496

8200 LOS Radio Module

8200-4000, 8200-6000

SPECIFICATIONS - 8200-4000 and 8200-6000

8200-4014-1	Modem for external radio
FSK Freq. Assign	Bell 202 CCITT V.23
	M=1200 M=1300
	S=2200 S=2100
Push to Talk (PTT)	Isolated or Grounded
Audio Level Adjust	50 mv to 4.0 V p/p
Baud Rate	1200 bps
Operating Temp.	-40 to +60°C
Power Consumption	5 ma Quiescent
Audio Impedance	600 Ohms
Twisted Pair Capability	Standard
8200-6014-1	Radio with modem
Transmitter Power	4 Watts
Frequency Stability	+/- 5 ppm over Temp.
Rec. Standby Current	22 ma @ 12.5 VDC
Transmitter Current	1,350 ma
Operating Temp.	-30°C to +50°C
Receiver Sensitivity	12 dB sinad: < .45 uV
Tx. Carrier Attack Time	<10 ms
Tx. Conducted Spurs	>52 dBc
Deviation	+/- 5 Khz (max)
VHF or UHF bands	136-174, 403-424, 450-470 Mhz
	FCC Certified
Transceiver	
Size	Mounts in the internal card slot of the 8200
	Type-N female
Connector (Front Panel)	

SPECIFICATIONS - 8200-5000 Satellite Radio Module

Output Frequency	GOES: 401.701 to 401.998 MHz
	Intnat'l: 402.0025 to 402.0985 MHz
	Tunable to Meteosat Bands
Frequency Stability	+/- .5 ppm over temperature
Harmonics	+/- .5 ppm/year aging
Spurious	> 60dBc
Phase Noise	Meets NESDIS specification
Tx Power	<3 deg RMS (2BL=20 Hz)
Modulation	8.5 Watts +/- .5 dB (Factory Set)
	Bi-Phase Manchester Encoded NRZ data (+/- 60 deg)
Data Rate	100 Bps
Power Req.	12.5 Volts +/- 2 Volts, 11 mA quiescent, 3.5A nom. Transmit
Temp. Range	-40 to +60°C. Operating
	-65 to 100°C Storage(no batt.)

Appendix B

Blank Setup Sheets

8200 SENSOR SETUP

UnitID _____

Location _____

Name _____

SYSTEM SETUP\ENABLE SENSORS

8200 Sensor Name						
Enable ON/OFF						
New Name (optional)						

SYSTEM SETUP\CONFIG SENSORS

Measure ON/OFF						
Log ON/OFF						
Average ON/OFF						
Intrval 00:00:00						
Value (Forced) 0000.000						
Slope 0000.000						
Offset 0000.000						
Elevation 0000.000						
RightDigits 0-3						

SYSTEM SETUP\ALARM OPTIONS

Enable						
Groups (GOES ONLY)						
Control						
Trend (MODEM ONLY)						
High Alarm						
Low Alarm						
ROC Alarm						
HiLev						
LoLev						
ROCLev						
DeadBnd						
Prefix (MODEM ONLY)						
Suffix (MODEM ONLY)						

General Setup

SYSTEM SETUP\Measurement Schedule

MeasInt	
SampInt	
MeasTim	
SampTim	
PwrTim	
#Samples/Set	
#Measmnt/Log	
BasInt	
BasTim	
PwrMode	

EEROM SETUP

Serial		USER
User Rate		9600
Radio Rate		1200
Com Rate		1200
Dump Rate		9600
SDI Rate		1200
Enter Reqd		OFF
Log Dump		ALLBIN
TimeLimit		60
PowerDelay		1
PressDelay		5
AnalgDelay		5
AutoKey		(blank)
TimeFmt		NORMAL
DateFmt		MDY
BasicSize		1

PROTOCOL SETUP

Master		(blank)
CarrierDly		7
ReplyDelay		0
ACK Delay		100
TN Rate		00:00:00
TA Rate		00:10:00
RetryIn		00:01:00
# Retries		3
Use RS-485		
Long Packets		
HW Handshake		

GOES Radio Setup

Tx Mode	
SatID	
Internatl	
Format ST	
Carrier ST	
Channel ST	
Time ST	
Rate ST	
#Data/TX ST	
DatTmST	
DatInST	

Random Setup Menu

Channel RR	
RN Rate	
RA Rate	
#TX/Alarm RR	
AlmInRR	
#Data/TX RR	
DatTmRR	
DatInRR	

MODEM Setup

Dial-Out	
AnswerMode	
Number Rings	
PhonePass	
DialIn	
DialOut	
#1:	
#2:	
#3:	
Redial	

Appendix C

Assembly Drawings

Appendix D

GOES Transmission Format

Sutron 8200 Goes Transmission Format

The 8200 supports 3 different transmission formats, they are:

1) Random Binary (6-bit binary code)
2) Self Timed Binary (6-bit binary code)
3) Self Timed SHEF (Standard Decimal Format, similar to SHEF)

This document first describes the general transmission format followed by details on each of the formats transmitted by the 8200.

TRANSMISSION FORMAT

Every GOES transmission consists of :

<CARRIER> <ONE-ZERO> <MLS> <ID> <DATA> <EOT>

where:

CARRIER — The length of <CARRIER> is 0.55 seconds for short transmissions and 4.95 seconds for long transmissions. Random transmissions are always short and international transmissions are always self timed and long. Domestic self timed transmissions may use short or long carrier depending on the application.

ONE-ZERO — The length of <ONE-ZERO> is 0.50 seconds for short transmissions and 2.42 seconds for long transmissions.

MLS — The <MLS> is always a 15-bit sequence expressed in binary as: 100010011010111 (most significant bit first). Data is always sent at 100 bits per second, so the <MLS> takes 0.15 seconds to send.

ID — The sattelite <ID> of the data recorder is a BCH coded address word issued as a 31 bit hexadecimal number. The <ID> is sent MSB first. The <ID> requires 0.31 seconds to transmit.

DATA — The actual <DATA> contained in the transmission depends on the format being used and is described in detail later. The data itself is alway sent at 100 baud, Synchronous, 7 bit data with Odd parity. Only the printable ASCII characters between 32 <SPACE> and 126 <~> appear in the data portion of a message. Like RS232C, the least signigicant bit is sent first and the parity bit last.

EOT — For domestic transmission the <EOT> is the same as the ASCII EOT character or 00100000 in binary (MSB first). For international transmissions the <EOT> is a 31 bit sequence as follows: 0010000011011101110010100110001.

RANDOM BINARY DATA FORMAT

This format is used when the 8200 makes a random or alarm transmission. The format of the transmission data is:

```
<GROUP-ID> <OFFSET>
<SENSOR1-DATA> <SENSOR2-DATA> ... <SENSOR(N)-DATA>
<SENSOR1-DATA> <SENSOR2-DATA> ... <SENSOR(N)-DATA>
<SENSOR1-DATA> <SENSOR2-DATA> ... <SENSOR(N)-DATA>
...
 <COUNTER> <BATTERY>
```

where:

GROUP-ID The GROUP-ID is a one byte character, in the range 1 to 9, indicating the random group which caused the transmission.

OFFSET OFFSET is a 1 byte binary encoded number indicating the number of minutes ago the most recent data was recorded.

SENSOR-DATA The actual SENSOR-DATA contains only those sensors belonging to the random group which caused the alarm. The data values are 3 byte binary encoded signed numbers allowing a range of: -131072 to +131071. The actual 6-bit binary encoded format is described later. The 8200 will only transmit numbers in the range -32768 to +32767. The value transmitted is taken directly from the log of the 8200 which was scaled by Rightdigits before being placed in the log. The value transmitted will be value * 10^RightDigits. The string "///" will be sent if the data was never recorded or was erased.

The number of sensors transmitted depends on the number of sensors in the random group, and the number of log records sent depends on #Data/TX RR selected in the 8200. The most recent data is always sent first.

Note: if #Measmnt/Log is set > 1, the first value transmitted is the last measured value, not the last logged value. This has been done to support users who want data logged hourly (to conserve space) and still transmit randomly a value collected more often.

COUNTER COUNTER is a 2 byte binary encoded number which indicates the transmission number and increments after every transmission. The number will be between 0 and 4095.

BATTERY BATTERY is a 1 byte binary encoded number representing the battery voltage of the 8200 before the transmission. The range of the number will be -32 to +31 and can be converted to volts by multiplying by 0.234 and adding 10.6 allowing a range of 3.1 to 18.1 volts.

EXAMPLE:

Here is a message with 2 data items per transmission and with three sensors enabled in random group 2.
This message assumes that #measmnt/log = 1.

```
2@@Gt@Sx@@i@Gs@Sr@@i@GI
|||  |  |  |  |  |  | |
|||  |  |  |  |  |  | +- Battery Voltage
|||  |  |  |  |  |  +--- Random Counter
|||  |  |  |  |  +------ Temp #2
|||  |  |  |  +--------- Precip #2
|||  |  |  +------------ Stage #2
|||  |  +--------------- Temp   #1
|||  +------------------ Precip #1
||+--------------------- Stage  #1
|+---------------------- Delta Time
+----------------------- Group ID
```

The time stamp for the values is based on DatTimRR and DatIntRR. A transmission made at 10:28 would have the 10:15 (#1) and 10:00 (#2) data if DatTimRR=00:00:00 and DatIntRR=00:15:00. If DatTimRR=00:00:00 and DatIntRR=01:00:00 the data would be at 10:00 (#1) and 9:00 (#2)

If #measmnt/log were > 1, the message would appear as follows:

Here is a message with 2 data items per transmission and with three sensors enabled in random group 2:

```
2@@Gt@Sx@@i@Gs@Sr@@i@GI
|||  |  |  |  |  |  | |
|||  |  |  |  |  |  | +- Battery Voltage
|||  |  |  |  |  |  +--- Random Counter
|||  |  |  |  |  +------ Temp #1 (based on DatTimRR and DatIntRR)
|||  |  |  |  +--------- Precip #1 (based on DatTimRR and DatIntRR)
|||  |  |  +------------ Stage #1 (based on DatTimRR and DatIntRR)
|||  |  +--------------- Temp   #1 (last measured value)
|||  +------------------ Precip #1 (last measured value)
||+--------------------- Stage  #1 (last measured value)
|+---------------------- Offset Time
+----------------------- Group ID
```

The time stamp for these values is a bit different than that in the first example. In this later case, the 8200 sends the last measured value for each sensor first. The time stamp for these sensors would be the last nearest measurement time. The first data from the log (#1) would have the same time stamp as before.

SELF TIMED BINARY DATA FORMAT

This format is used when the 8200 makes a self-timed transmission and the format has been set to BINARY. The format of the transmission data is:

```
<BLOCK-IDENTIFIER> <GROUP-ID> <OFFSET>
<SENSOR1-DATA> <SENSOR2-DATA> ... <SENSOR(N)-DATA>
<SENSOR1-DATA> <SENSOR2-DATA> ... <SENSOR(N)-DATA> ...
<SENSOR1-DATA> <SENSOR2-DATA> ... <SENSOR(N)-DATA>
 <BATTERY>
```

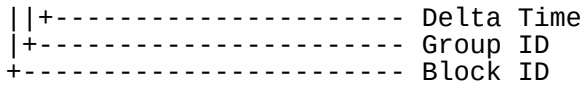
where:

BLOCK-IDENTIFIER	BLOCK-IDENTIFIER is always sent as "B" to indicate the start of a binary data group.
GROUP-ID	GROUP-ID is always sent as "1" to indicate the self timed group.
OFFSET	After the group id, the actual data from the 8200's log are sent. Each record is prefixed with an <OFFSET>, which is a 1 byte binary encoded number indicating the number of minutes ago the most recent data was recorded.
SENSOR-DATA	SENSOR-DATA contains only those sensors belonging to the self timed group (number 1). The data values are 3 byte binary encoded signed numbers allowing a range of: -131072 to +131071. The actual 6-bit binary encoded format is described later. The 8200 will only transmit numbers in the range -32768 to +32767. The value transmitted is taken directly from the log of the 8200 which was scaled by Rightdigits before being placed in the log. The value transmitted will be value * 10^RightDigits. The string "///" will be sent if the data was never recorded or was erased. The number of sensors transmitted depends on the number of sensors in the self timed group, and the number of log records sent depends on the Number of Data Items selected in the 8200. The most recent data is always sent first.
BATTERY	BATTERY is a 1 byte binary encoded number representing the battery voltage of the 8200 before the transmission. The range of the number will be -32 to +31 and can be converted to volts by multiplying by 0.234 and adding 10.6 allowing a range of 3.1 to 18.1 volts.

EXAMPLE:

Here is a message with 2 data items per transmission and with three sensors enabled in the selftimed group:

```
B1@@Gt@Sx@@i@Gs@Sr@@iI
||||  |  |  |  |  +--- Battery Voltage
||||  |  |  |  +------ Temp #2
||||  |  |  +--------- Precip #2
||||  |  +------------ Stage #2
||||  +--------------- Temp   #1
||||+------------------ Precip #1
|||+------------------- Stage  #1
```


||+---------------------- Delta Time
|+----------------------- Group ID
+------------------------ Block ID

SELF TIMED SHEF DATA FORMAT

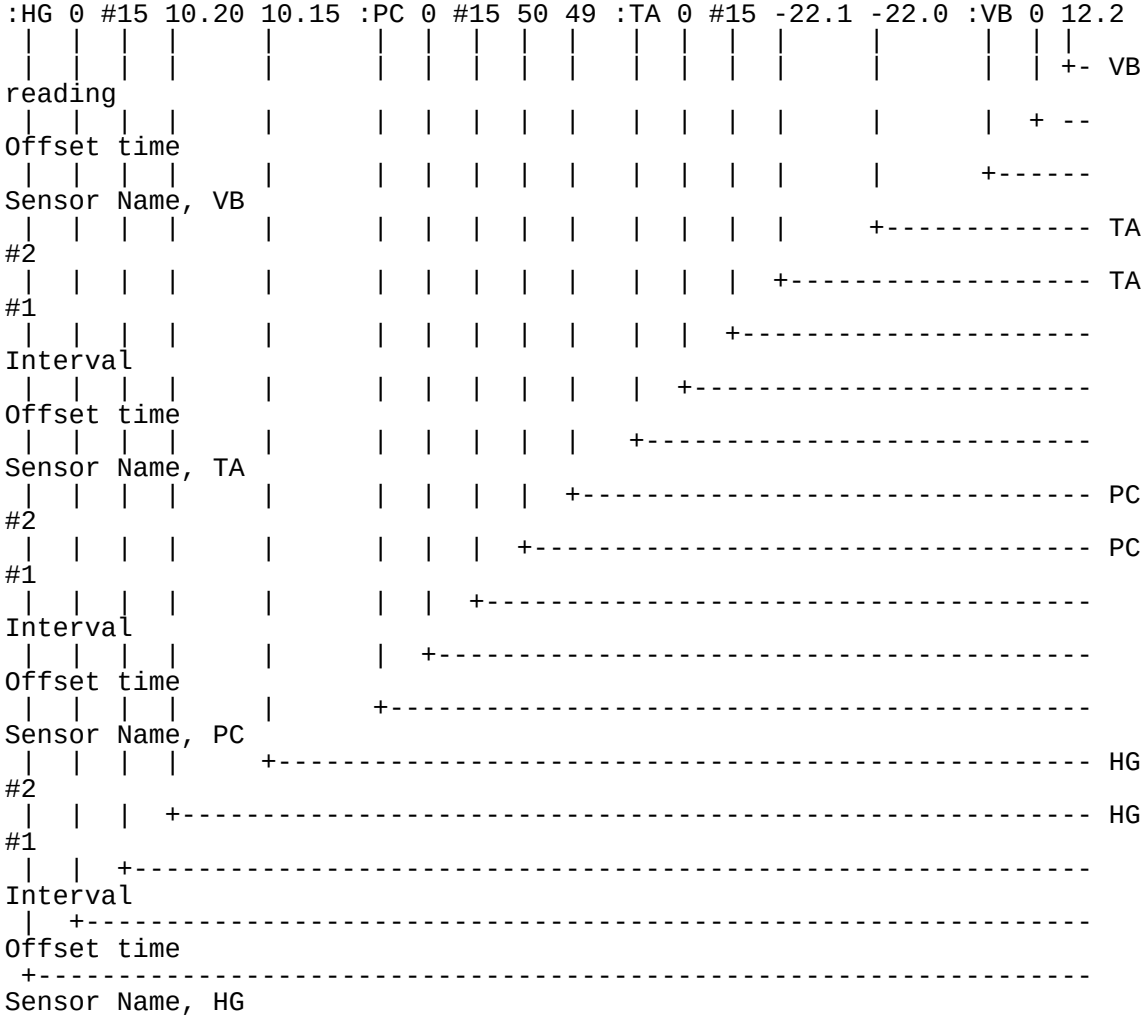
This format is used when the 8200 makes a self-timed transmission and the format has been set to SHEF. The format of the transmission data is:

```
":" <NAME1> <OFFSET> "#"<INTERVAL> <DATA1> <DATA1> ... <DATA1)>
":" <NAME2> <OFFSET> "#"<INTERVAL> <DATA2> <DATA2> ... <DATA2>    ...
":" <NAME(N)> <OFFSET> "#"<INTERVAL> <DATA(N)> <DATA(N)> ... <DATA(N)>
":" <BATTERY-NAME> <OFFSET> <BATTERY>
```

NAME	is the sensor name or SHEF CODE as entered in the 8200 in the enable sensor menu. SHEF CODES are usually two digit codes and you will have to look up the appropriate codes for your sensors. So, for instance the SHEF CODE for gage height is HG, cumulative precipitation is PC, air temperature is TA, and battery voltage is VB.
OFFSET	After the group id, the actual data from the 8200's log are sent. Each record is prefixed with an <OFFSET>, which is an ASCII number indicating the number of minutes ago the most recent data was recorded.
INTERVAL	INTERVAL indicates the interval in minutes between transmitted sensor data items. The 8200 always uses the same interval for every sensor. The interval is called the Data Interval in the 8200 GOES setup menu.
DATA	Unlike the binary formats, the SHEF format groups all the related sensor <DATA> together. So, the data line for precipitation would contain the most recent precip data first followed by the next oldest, etc. One entry is generated for each sensor in the self timed group (number 1). The data is transmitted in ASCII with sign and decimal point (if needed). If a data value has not yet been recorded (or has been erased) the letter "M" for missing data will be sent. The number of sensors transmitted depends on the number of sensors in the self timed group, and the number of log records sent depends on the Number of Data Items selected in the 8200. The most recent data is always sent first.
BATTERY	After all of the sensors and data have been sent on last entry will be transmitted containing the battery voltage. <BATTERY-NAME> will contain the SHEF code assigned to Battery voltage in the 8200. <OFFSET> will be the same as for other entries and <BATTERY> will contain the 8200 battery voltage as measured just before transmitting.

EXAMPLE:

Here is a message with 2 data items per transmission and with three sensors enabled in the selftimed group, notice how much longer this message is compared to the earlier binary examples:



Note: the names HG, PC, TA are the sensor names assigned by the person setting up the 8200. If the default names are used they might be Encoder1 (HG), Counter (PC), Analog1 (TA), Battery (VB).

SIX-BIT BINARY ENCODED FORMAT

The six bit binary format is used to encode numbers into displayable ASCII characters. Notice that fractional numbers cannot be represented, so for instance a battery voltage of 13.04 volts setup with 2 right digits will be sent as 1304.

A 1 byte encoded number can range from -32 to +31.
A 2 byte encoded number can range from -2048 to +2047
A 3 byte encoded number can range from -131072 to +131071

Binary encoded numbers are always sent most significant bytes first. The number itself is broken down into 6-bit digits, and each digit is placed in one byte of data. The number 64 (ASCII "@") is added to each digit to make it fall within the range of displayable ASCII characters. The only exception is that 127 (ASCII <DEL>) is sent as 63 (ASCII "?")

Example 1. Encoding the number 10 in 1 byte:
Since 10 will fit in 6-bits we only have to add 64 which would yield 74. So the number 10 would appear as ASCII 74 or the letter "J".

Example 2. Encoding the number 12345 in 3 bytes:
First we have to convert 12345 into binary in 6-bit pieces:
12345 (base 10) = 11 000000 111001 (base 2)
Now we can convert each piece back to base 10:
11 000000 111001 (base 2) = 3, 0, 57
Finally, we add 64 to each piece and convert to ASCII:
67, 64, 121 = ASCII "C@y"

Example 3. Encoding the number -12345 in 3 bytes:
First we have to convert -12345 into two's complement 18-bit binary: -12345 (base 10) = 111100 111111 000111 (base 2)
Now we can convert each piece back to base 10: 111100 111111 000111 (base 2) = 60, 63, 7
Finally, we add 64 to each piece and convert to ASCII (since the second piece is 63 we leave it alone):
124, 63, 71 = ASCII "|?G"

Example 4. Decoding the 3 byte string "@SW":
This is just like encoding except we follow the steps backwards.
First we convert all the characters to ASCII decimal codes:
ASCII "@SW" = 64, 83, 87
Now we subtract 64 from each piece and convert to 6 bit binary:
0, 19, 23 = 000000 010011 010111
Finally, we combine all the bits to form one 18-bit twos complement number and convert to base 10:
000000010011010111 = 1239

Appendix E

8200 Test Set Software

Introduction

Sutron provides this test set software to simplify the process of operating the 8200. The software allows you to communicate serially with the 8200, download data serially into .LOG files, download RAM CARDS (RAMPACKS with a rampack reader) and output .LOG files, convert a .LOG to ASCII (comma delimited) .PRN file, compute daily means, min, and max, and to perform a quick plot of the data. The programs contained on the disk are not copy protected, and we encourage the user to make as many working and backup copies as needed. Additional copies of the software and the 8200 Users Manual are available from Sutron at a nominal price.

Installation

To install this software on a hard disk, create a new directory
and use the copy command to copy the contents of this disk.
Example:

```
C:\> Md 8200
C:\> Cd \8200
C:\8200> Copy A:*.*
```

In the future you may reach the 8200 directory with the change directory command.
Example:

```
C:\> Cd \8200
```

The disk contains the following files:

File	Description
README.TXT	Important information about the programs.
LICENSE.TXT	Contains software license information.
TS8210.EXE	Test set software, communicate serially with an 8200. This replaces the older TS8200 software.
LOGPRN.EXE	Converts .LOG files to ASCII .PRN files.
TS8200.EXE,TS.EXE	Special, previous versions of TS8200, useful for debugging
HEADER.EXE	Displays the header information of a .LOG file.
CHKLOG.EXE	Verifies the check sum of a .LOG file.
RAMCARD.EXE	Reads a RAM CARD (PCMCIA) and outputs a LOG file
RAMPACK.EXE	Reads a rampack and outputs a .LOG file
LOGSTAT.EXE	Reads a .LOG file and output daily statistics.
LOGPLOT.EXE	Graphically plots a .LOG file to a CGA compatible display.
LIST.COM	Views ASCII files (shareware software).
DEMO0101.LOG	Sample .LOG data file from Sutron's weather station
SETMGR.EXE	Displays 8200 setup files and converts between versions

Each of the programs is described in the following sections.

Appendix E -- 8200 Test Set Software

TS8210

This program is the test set software for the 8200. It allows a PC to communicate serially using COM1 or COM2 to an 8200. Using TS8210 you will be able to:

- display complete menus for the 8200
- manual setup of the 8200
- upload (send) and download (receive) setups and basic programs
- download (receive) data
- manual test of 8210 and display status and troubleshooting information.

> Note: These same functions can also be performed by most other communications programs such as PC ANYWHERE, PROCOMM, CROSSTALK. TS8210 is a communications program. You may use these other programs in place of TS8210 if you like.

Running TS8210

TS8210 is run by simply executing the command TS8210 and the MS-DOS prompt. Make sure TS8210 is in the current directory or path. TS8210 accepts command line arguments to set the baud rate and communications port. These can also be set after the program is running. The format of the arguments is of the form COMx:baud. For example the command TS8210 COM2:4800 would start TS8210 running on COM2 at 4800 baud.

Communications Window

When TS8210 is run it displays a communications window. The window has some text at the bottom of the display and leaves the rest of the display for showing the communications and prompts from the 8200. The communications area may be blank or filled with information depending on whether the program is communicating with an 8200.

The labels across the bottom appear as shown in the following example:

```
TS8210 V1.0   F1=EXIT   F2=SETUP   F3=XYMODEM          F10=RESET   (C)1995 Sutron Corp
```

TS8210 V1.0	Program name and version
F1=EXIT	label for the F1 key. Press F1 to exit the program.
F2=SETUP	label for the F2 key. Press F2 to change the port (COM1, COM2), change the baud rate, and change the display colors.
F3=XYMODEM	label for the F3 key. Press F3 to start an XMODEM or YMODEM transfer of setup of data. This may be done only after selecting the proper menu on the 8200.
F10=RESET	label for the F10 key. Press F10 for a RESET of communications. RESET turns off the DTR, DSR lines on the communications port, sends a BREAK, and turns them on again. Use this after communications times-out with the 8200.
(C)1995 Sutron Corp	Copyright notice.

In addition, TS8210 also supports F4 as a function key to push to DOS. Even though it does not show up in the labels, pressing F4 does a push to DOS. Be sure to type EXIT to return to the program.

Using TS8210 Menus

When you press SETUP or XYMODEM, TS8210 will display its own menus. To work with these menus you should understand the following conventions:

- If you have a mouse, you may click on fields and controls as desired.
- If a field or control is has a letter/number highlighted, you may select it by press ALT along with the letter or number. For example COM1 has the 1 highlighted. Pressing ALT-1 causes COM1 to be selected.
- You may press TAB to move between fields and controls. Each time you press TAB you will see the cursor move to highlight a different control or field. Within a field (such as baud rate) you may use the arrows to select the desired option.

SETUP

Pressing the F2=SETUP key brings up several menus that allow you to set the com port, baud rate, foreground and background colors. The first menu is for setting the com port and baud rate. Use the conventions explained above to set the desired communications port and baud rate. For example, to set the com port to COM2:

- click the ( ) in front of COM2 with a mouse, then click on OK

or if you do not have a mouse you might try either:

- press ALT-2 to select COM2, then press ALT-O for OK

- or -

- TAB until the cursor is on COM1. Use the down arrow to select COM2. Then TAB until OK is highlighted and press ENTER.

After setting the communications port and baud rate, you will be able to set the foreground and background colors. The foreground color is the color of the highlights at the bottom of the screen. The background color is the color of the screen and the text in at the bottom. You can set the foreground and background color to make the screen more readable or pleasant to look at. Simply use the arrow keys to move the box to select the desired color and press ENTER.

XYMODEM

TS8210 is programmed to automatically display the Transfer Protocol menu whenever certain menus are used on the 8200. You can also display the Transfer Protocol menu by pressing F3=XYMODEM. However, it will not be able to make a transfer if you have not already used the proper 8200 menu to initiate the transfer. Therefore, under most circumstances there is no need to press the XYMODEM key. The software will do it automatically whenever a transfer is initiated.

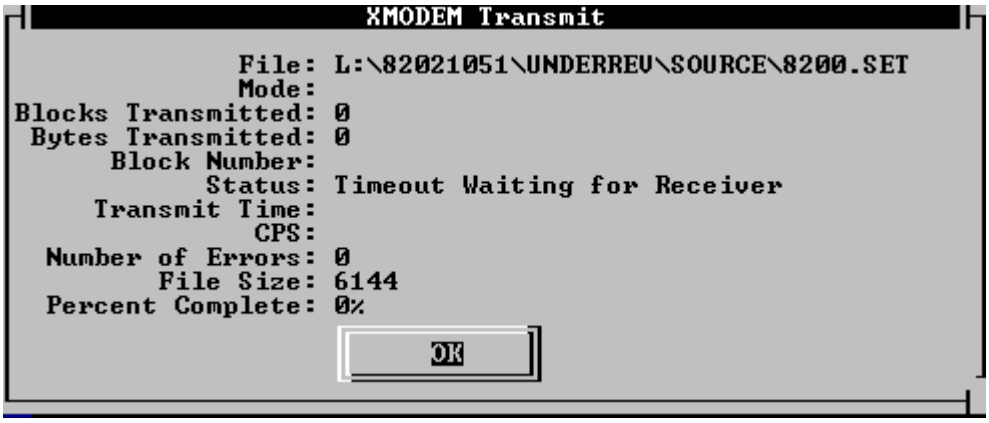
For example, if you use the 8200 Upload/Download\Transfer Setup command, the 8200 will trigger TS8210 to display the following:

Notice that the transfer defaults to Receive File. If you want to receive the setup, press ENTER. The 8200 will automatically begin a Y-MODEM transfer to send the setup. It will name the setup as unitid.SET. TS8210 will receive the file and store it in the default directory. However, if the file already exists, it will prompt you to either overwrite the file or enter a new file name.

When receiving the BASIC program, the 8210 will name the file unitid.BAS. You will be prompted to overwrite or enter a new file name if the file already exists.

When receiving the LOG file, the 8200 will name the file unitidMMDD.LOG. You will be prompted to overwrite or enter a new file name if the file already exists.

Watch the message box that tracks the progress of the file transfer. When the transfer is complete, a "complete" message is displayed and the software waits for you to press OK. IF the transfer fails, a message will be displayed and you must press OK to proceed.



If you want to send a file (setup or basic program) to the 8200, you must select Send File (use mouse, ALT-S or TAB and arrows to select it). The program will set the default protocol to XMODEM. XMODEM will work fine for all transfers to 8200s. When you press OK, the software will prompt you for the name of the file to enter. If the transfer program began automatically, the proper file name extension will be included in the filename box. Select a file from the list boxes or type the name of the file you want to send. Then press OK and the transfer will begin.

As in receiving files, watch the message box that tracks the progress of the file transfer. When the transfer is complete, a "complete" message is displayed and the software waits for you to press OK. IF the transfer fails, a message will be displayed and you must press OK to proceed.

LOGPLOT

The LOGPLOT program is used to display graphs of data in LOG files. The LOG files are created by downloading the data from an 8200. The format of this file is binary.

To display a graph of the data in the file, start the LOGPLOT program by issuing the command:

LOGPLOT filename

where filename is the name of the file to plot. If you omit the name, LOGPLOT will prompt for it.

If the file is found and in the proper LOG format, LOGPLOT will display a screen listing all the sensors found in the file. Prompts at the top of the screen explain how to use the program. Select the sensors you want to plot by using the up/down arrows to move the pointer to a sensor. Press ENTER to select or deselect a sensor.

When you have selected all the sensors you desire, press P to generate a plot. The software will prompt for you to enter a MIN and MAX value for the plot. You may enter your desired values for the MIN and MAX or accept the defaults by pressing ENTER. After this is done, the graph is displayed. The software will have also read in the values for the sensors it plotted and can now suggest better values for the MIN and MAX. To do this press ESC to go back to the selection menu and press P again. This time, the software uses the actual MIN and MAX values from the last plot for the values it suggests as defaults. You may use these values by pressing ENTER or enter your own by typing the value followed by ENTER. You may want to round up or down the numbers suggested by the program to improve the plot labeling.

With the graph on the display you can use several keys to control the display. The keys are defined as follows:

Viewing Options

1 to 9	-- View 1 to 9 days of data at a time
W	-- View a week of data (7 days)
M	-- View a month of data (31 days)
Y	-- View a year of data (365 days)
F, B	-- Change Foreground and Background colors

Movement Arrows

Right Arrow	-- view next screen of data
Left Arrow	-- view previous screen of data

Saving Options

Shift F1 to F9	--Save current screen to memory
F1 to F9	--Recall screen saved by Shift F1 to F9

Other Options

Shift-PRTSCR	--Print Graph (if GRAPHICS.COM was run)
?	--Display help screen
ESC	--exit

The default colors have been set to improve the chances that graphs will appear on LAPTOP black and white displays. If they still do not appear, try toggling the foreground and background colors to see if that helps.

LOGPRN

Conversion of .LOG files to spreadsheet usable ASCII files is done using the LOGPRN program. You should have received the LOGPRN program on a diskette with your RAM Pack Reader. LOGPRN can either be executed directly from the diskette or loaded on to a hard disk.

When you execute the LOGPRN program you will see the following screen display:

```
LOGPRN Convert V1.7 (.Log to .Prn)

Options  - /X = exclude non recorded data items
         - /Z = Zero non recorded data items
         - /S = display Seconds
         - /J = display Julian day number
         - /F = fixed column output
         - /B = insert Blank line between days
         - /H = output in HYDATA format
         - /T = output Today's data
         - /Y = output Yesterday data
         - /SYYMMDD = specifies start date
         - /EYYMMDD = specifies end date
Input File:
```

At this point, LOGPRN is expecting you to type in the name of an existing .LOG file followed by a carriage return, for example:

DEMO0101

If you have entered a correct file name, and if the program can locate the file you will see the following messages:

- Creating: xxxxmmdd.PRN
- Reading Descriptor
- Reading Sensor Inf.
- Writing Header
- Writing Data ... Date: mm/dd/yyyy hh:mm:ss
- Complete.

Where xxxxmmdd is the same as the input file name, and mm/dd/yyyy is the current date being converted.

The LOGPRN program allows you to choose several options in the way that data from the RAM Pack are converted. The options are selected by typing LOGPRN followed by the option selector. For example:

LOGPRN xxxmmdd /X

You may select more that one option at a time as long as they are not mutually exclusive.
The first two options, /X and /Z control the way the conversion of null data items. Null items can either be ignored, or they may be zeroes. The second options control time and date display in the converted data. /S tells the program to time tag to seconds. /J changes the date display from month/day to the Julian numbering system.

The file format is designed to be spreadsheet compatible. When using LOTUS 123 a .PRN file is read in by using the /FIN (File Import Numbers) command. By using the /FIN command the data will be imported in the correct number of columns in numeric form.

LOGSTAT

LOGSTAT generates simple statistics from the data in a LOG file. The program computes the daily min, max, average as well as the number of samples for each sensor in the file. The output of LOGSTAT is displayed on the screen. If you want to save the output in a file, redirect the output using >. For example, to generate statistics on a file named BUOY1012.LOG and save the data as STAT1012, use the following command:

LOGSTAT BUOY1012 > STAT1012

HEADER

This program simply displays the header for the LOG file. Since a LOG file is binary, you cannot know what is in it without a program such as HEADER. The header contains information on the start date, number of sensors, amount of data. It does not give the names of the sensors.

LIST

LIST is supplied as a courtesy to our customers, the software is copyrighted by Vernon D. Buerg and may not be sold. The author requests a gift of $15 or any amount if you find the program of value. For more information enter "LIST filename" and press "?" to view a help screen. LIST also accepts wildcard filenames so for instance to view all the .PRN files - enter "LIST *.PRN". To view the next file press CTRL-PGDN or to see the previous enter CTRL-PGUP. Also if you are logging a lot of sensors, the

LOGSTAT output may exceed 80 characters per line. In this case you can output the summary to a file with "LOGSTAT filename >SUMMARY.TXT". Then you can enter "LIST SUMMARY.TXT" and use the LEFT-ARROW and RIGHT-ARROW keys to view the parts of the line which do not fit on the screen.

TS8200, TS

TS8200 and TS are old versions of the 8200 communications software. The programs do not know how to do XMODEM communications. TS8200 can do a fast dump of memory which takes less time than the corresponding TS8210 XYMODEM transfers. TS is a special version of TS8200 which is useful for debugging because it can display characters in ASCII, hex, and decimal. Use F3- Mode, to change the type of display you desire. TS can also toggle the DTR line (F10) which can be used to key and unkey base station radios, or an 8200 set up as a base station radio.

CHKLOG

This program can be run on any .LOG file to determine whether the contents of the file are valid. For instance, although an upload using TS8200 may fail due to a dropped character, the received data is still written in to a file. If you do not see the Passed or Failed message you may not know whether to trust the data. By running CHKLOG on this file you can tell if it was corrupted.

SETMGR

This program displays and converts 8200, 8200A, or 8210 binary setup files.

- display the contents of setup file
- convert a binary setup from one version to another
- convert a binary setup to an editable ASCII text file
- convert a text file back to a binary setup file

Using SETMGR.EXE you can display the contents of a binary setup file. You can also convert the file to be compatible with different models of the 8200. SETMGR.EXE may even be used to make simple edits to a setup by converting a binary setup to an ASCII text file, editing that text file, and then converting the text file back to a binary setup file.

Supported Models

SETMGR.EXE only work with setups from 8200's running Version 3 or 4 software. Setup files from previous versions are not supported. As new versions are released, they should remain compatible with the above versions. If not, a change will be made to SETMGR.

Uploading / Downloading Setups

Operation

SETMGR.EXE is a DOS program. It is run by typing the command SETMGR at the DOS prompt. Optional arguments to the command are used to specify the input file and selected functions. The full syntax of the command is as follows:

SETMGR [input_file] [output_file] [/version] [>output_dest]

where items in [] are optional and

input_file	Specifies the file to display or convert. The software will prompt for the file name if it is omitted. If this file has an extension of ".TXT" then it is assumed to specify an ASCII setup file - otherwise it is expected to be the name of a binary setup file with an extension of ".SET".
output_file	Specifes the file to output after conversion. If this file has an extension of ".TXT" then ASCII setup information is output - otherwise binary setup information is output.
/version	Specifies the setup version to output.
>output_dest	A DOS command to redirect the output to the named file or device. It is only valid for a display function (output_file is not entered).

Displaying a Setup

To display a setup, type SETMGR and press ENTER. The program will prompt for a file name. The contents of the file will be displayed on the screen. You can also type SETMGR followed by the name of the setup file. Make sure to include the extension name of the file as the program does not add anything to the file name before opening it. For example, the command

SETMGR S23.SET

will cause the contents of the setup file to be displayed on the screen.

To redirect the output to a file, add the ">output_dest" to the command. For example, the command

SETMGR S23.SET >S23.DAT

redirects the output from the screen to the file named S23.DAT. This file can then be viewed by a conventional program such as EDIT or LIST and then printed.

Help

If you type the command followed by a "/?", a help screen will be displayed. For example, SETMGR /?, will cause the help screen to be displayed.

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```
C:> SETMGR /?

8200 Setup Manager, (C)1996 Sutron Corporation, Version 1.0
Usage: SETMGR [input_file] [output_file] [/version]
   input_file  = setup file to display or convert
   output_file = file to contain the converted setup
   /version    = version number to convert input to
The following versions are supported:
   /V3  = V3.x 8200 Basic        /V3A = V3.x 8200A Basic
   /R3  = R3.x 8200 LOS Radio    /R3A = R3.x 8200A LOS RADIO
   /R38 = R3.8 8200 LOS Radio    /R37 = R3.7 8200A LOS RADIO
   /S3  = S3.x 8200 Speech Modem /S3A = S3.x 8200A Speech Modem
   /G3  = G3.x 8200 GOES Radio   /G3A = G3.x 8200A GOES Radio
   /V40 = V4.0 8210/8200A
Notes:
   An input_file with .TXT extension causes an ASCII file to be read in
   An output_file with .TXT extension causes an ASCII file to be output
Examples:
   SetMgr lake.set              (lake.set is displayed)
   SetMgr lake.set >setup.dat   (output directed to a file)
   SetMgr                       (program will prompt for setup file name)
   SetMgr lake.set G3A.set /V40 (convert to an 8210 setup file)
   SetMgr lake.set lake.txt     (convert a setup to an ASCII file)
   SetMgr lake.txt lake.set     (convert an ASCII file to a setup file
```

Sample Output

The following pages are an example of a setup that has been printed.
8210/8200 Setup File Listing

```
C:\> SETMGR WEATHER.SET

MAIN SETUP
 EPROM Version:              S3A
 Unit ID:                 WEATHER
 Measurement Interval:   00:15:00
 Sampling Interval:      00:00:01
 Measurment Time:        00:00:00
 Sampling Time:          00:00:00
 Switched Power Time:    00:00:00
 Samples to Average:          900
 Measurements per Log:          1
 Switched Power Mode:          ON
 Auto Record                  Yes
 Basic Run Interval:     00:00:06
 Basic Run Time:         00:00:00
 Password:                  PASWD
 Number Resets:                 0
 Log Size:                 126976
 ROM Checksum:              65222

EEROM SETUP
 Serial Port Mode:           USER
 User Baud Rate:             9600
 Radio Baud Rate:
 Com Baud Rate:
 Transfer Baud Rate:         9600
 SDI-12 Baud Rate:           1200
 Enter Key Reqd:               No
 Log Dump Mode:           ALL-BIN
 User Time Limit:               60
 Power Delay:                    1
 Analog Delay:                   5
 Pressure Delay:                 5
 Auto Startup Keys:
 Time Format:              NORMAL
```

```
 Date Format:                DMY
 Term Xmit Delay:              0
 Basic Size:                   1
 Amp Gain:                   1.0

PROTOCOL SETUP
 Master Name:
 Carrier Delay:                7
 Reply Delay:                  0
 Ack Delay:                  100
 TX Normal Rate:        00:00:00
 TX Alarm Rate:         00:10:00
 Retry Interval:        00:01:00
 Number of Retries:            3
 Use RS-485 w/SDI-12:         No
 Long SSP Packets:
 H/W Handshake on COM:
 Auto Dump to RAM Card:

SENSOR SETUP
 Sensor #:             1         4         8         9        12
 Name:           AirTemp BaroPress    Precip  SolarRad  RainFall
 Enable:             Yes       Yes       Yes       Yes       Yes
 Measure:            Yes       Yes        No       Yes       Yes
 Log:                Yes       Yes       Yes       Yes       Yes
 Average:             No        No        No        No        No
 Interval:      00:00:00  00:00:00  01:00:00  00:00:00  00:00:00
 Slope:           64.373    7.6117      0.01    2000.0      0.01
 Offset:           -99.1   -3.4938       0.0       0.0       0.0
 Elevation:            0         0         0         0         0
 Right Digits:         2         2         2         2         2
 Alarm Enable:        ON        ON        ON        ON        ON
 Groups:
 Control:             No        No        No        No        No
 Trend:               No        No        No        No        No
 High Alarm:         OFF       OFF       OFF       OFF       OFF
 Low Alarm:          OFF       OFF       OFF       OFF       OFF
 ROC Alarm:          OFF       OFF       OFF       OFF       OFF
 High Limit:         0.0       0.0       0.0       0.0       0.0
 Low Limit:          0.0       0.0       0.0       0.0       0.0
 ROC Level:          0.0       0.0       0.0       0.0       0.0
 Deadband:           0.0       0.0       0.0       0.0       0.0
 Name Phrase:          0         0         0         0         0
 Unit Phrase:          0         0         0         0         0
```

Appendix F

8200 Sutron Standard Protocol (SSP) Capabilities

Introduction

The 8200 has extensive support for Sutron Standard Protocol (SSP). SSP is a communications protocol which is similar but different in important ways from other protocols such as Xmodem. In particular, SSP is an extensible protocol (each message has an operation code and a length) which is capable of much more than just file transfer. SSP can be used for collecting real-time and logged data from an 8200, modifying setup and real-time variables, transmitting alarms, uploading/downloading setups and programs, setting the time, sending messages, and getting statuses. SSP is designed for half-duplex communication with multiple listeners, and uses CSMA for collision prevention, and CRC-16 for error detection. The 8200's SSP capabilities are fully exploited by Sutron's PC Base 2 master station software - and specific comments regarding how PC Base 2 supports the 8200 have been added to this document.

The general format for an SSP message is as follows:

DLE SOH to(n) / from(n) **DLE STX** flagseq(4) opcode len(2) data(len) **DLE ETX** crc16(2)

Numbers in parenthesis indicate the byte length of a field, (n) indicates a variable length field.

In addition, over a direct connect or a telephone connection SSP supports a s/w handshake to make sure that the receiver is ready before the transmitter sends a message. The sender first sends out a **RTS** character and waits for a **CTS** character before sending a packet. Usually the receiver sends a **CTS** character as soon as it is ready to receive which allows the sender to progress without delay.

Special characters used by SSP and their decimal ASCII values:

RTS=17=^Q	**CTS**=6=^F	**DLE**=16=^P	**SOH**=01=^A	**STX**=02=^B	**ETX**=03=^C

Opcodes used by SSP, and how they are used by the 8200:

Opcode	Description
Ack	00: Acknowledge an Opcode
Nak	01: Cannot perform an Opcode
CurdataReq	02: Request for Current data
Curdata	03: Current data report
TimeTagReq	04: Request for Timed data
TimeTag	05: Timed data report
TimeTagEnd	06: End of time tag data
SelfTest	07: Perform a selftest
ClearStatus	08: Clears system status
GetStatus	09: Request system status
SystemStatus	10: Here is the system status
StartSDL	11: Start recording
StopSDL	12: Stop recording
StartTag	13: Not supported
EvalTag	14: Measures a sensor
StopTag	15: Not supported

Opcode	Description
SetClock	17: Sets the time & date
Reset	18: Perform a reset
EraseSetup	19: Erases all setup information
SetupReq	20: Ask for setup
SetupChanged	22: Setup changed by terminal
TagInfo	23: 8200 Setup information
TagData	24: 8200 Setup & program data
TagEnd	25: End of this tag
SetupEnd	26: End of the setup
ValueReq	27: Request for sensor values
Value	28: Here are sensor values
Alarm	29: Alarm Exception Report
AllValueReq	39: Request all values for a sensor
AllValue	40: Here are all sensors
Mail	41: Here is a mail message

8200 Sensor Information

Each sensor in the 8200 can be accessed with SSP. The sensor contains more information that just the last recorded value. These values are documented below:

SSP Value #	PC Base 2 Value #	Description
0	1	Sensor Data
1	6	Sample Count
2	3	Slope
3	4	Offset
4	5	Right Digits
5	2 (*)	Sensor Enable Bits (low 16 bits) & Alarm Status Bits (high 16 bits)
6	7	Live Sensor Data - a measurement is made every time this is read.
7	8	Sensor Name
8	9	Elevation
9	10	Sensor Enable Bits
10	11	Alarm Enable Bits
11	12	Alarm Status Bits
12	13	High Limit
13	14	Low Limit
14	15	Deadband
15	16	Rate of Change
16	17	Name Phrase
17	18	Unit Phrase
18	19	Group Number
19	20	Last Tx Data
20	21	Min
21	22	Max
22	23	Std
23	24	Sum
24	25	N - Number of samples in last average

PC Base 2 Value#'s differ from the actual SSP value#'s in that they start at 1, and two values have been swapped for better uniformity between 8200 value's and Sutron's 9000 RTU values.

(*) PC Base 2 decodes just the alarm status bits of this field. When the sensor is not in alarm - PC Base 2 reports the string 'OK' for this value; otherwise the characters under the PC Base 2 Code column in Alarm Status Bits table are concatenated and reported.

Following are tables documenting values which contain bit fields:

Alarm Status Bits	Bit Value	PC Base 2 Code	Description
0	1	H	High limit Alarm
1	2	L	Low limit alarm
2	4	R	ROC alarm
3	8	+	Trend rising
4	16	-	Trend falling
5	32		Trend was rising
6	64		Trend was falling
7	128	A	An alert message has been triggered to the board in slot #1
8	256	A	An alert message has been triggered to the external serial port
9	512	A	An alert message has been triggered to the board in slot #2

Sensor Enable Bits	Bit Value	Description
0	1	Enable ON
1	2	Measure ON
2	4	Log ON
3	8	Average ON

Alarm Enable Bits	Bit Value	Description
0	1	Alarm Enable
1	2	Enable alerts to board in slot #1
2	4	Enable alerts to external serial port
3	8	Alarm condition toggles switched power
4	16	Alert on value above high limit
5	32	Alert on value below low limit
6	64	Alert on value above low limit
7	128	Alert on value below low limit
8	256	Alert on value above roc limit
9	512	Alert on value below roc limit
10	1024	Enable trending
11	2048	Enable alerts to board in slot #2

System Status Bits	Bit Value	Description
0	1	Recording ON
1..15		reserved
16	65,536	ROM Error
17	131,072	RAM Read/Write Error
18	262,144	EEROM Write Error
19	524,288	EEROM Check Sum Error
20	1,048,576	Analog Conversion Error
21	2,097,152	reserved
22	4,194,304	Goes Clock Stopped
23	8,388,608	Goes Clock Drifted

The SYSTAT Sensor

A special sensor called SYSTAT is available to be accessed by SSP to gather various system statistics. Much of this information is also encoded in the "Send to Sutron" GOES test message. These codes are documented under the **Tx Code** column.

Systat Field#	Tx Code	Field Name	Display Status Name	Description
1		Sample Status	Recording Status:	0=Cleared, 1=Disabled, 2=WaitPower, 3=WaitAverage, 4=Averaging, 5=WaitMeasure, 6=Measuring, 7=Logging
2		Min Battery	Battery Status:	Lowest measured value of the battery voltage
3		Max Battery	Battery Status:	Highest measured value of the battery voltage
4		Int. Rx Count	AUX: RX **A**/b,c bad TX d,e bad	# SSP messages addressed to the unit and received good on the internal modem or radio.
5		Int. Rx Total	AUX: RX a/**B**,c bad TX d,e bad	# SSP messages addressed to any unit and recieved good on the internal modem or radio.
6		Int. Rx Bad	AUX: RX a/b,**C** bad TX d,e bad	# SSP messages recieved bad on the internal modem or radio.
7		Int. Tx Count	AUX: RX a/b,c bad TX **D**,e bad	# SSP message sent on the internal modem or radio.
8		Int. Tx Bad	AUX: RX a/b,c bad TX d,**E** bad	# SSP messages which timed out and had to be retried on the internal modem or radio.
9		Ext. Rx Count	TERM: RX **A**/b,c bad TX d,e bad	# SSP messages addressed to the unit and received good on an external modem, radio, or direct connect.
10		Ext. Rx Total	TERM: RX a/**B**,c bad TX d,e bad	# SSP messages addressed to any unit and recieved good on an external modem, radio, or direct connect.
11		Ext. Rx Bad	TERM: RX a/b,**C** bad TX d,e bad	# SSP messages recieved bad on an external modem, radio, or direct connect.
12		Ext. Tx Count	TERM: RX a/b,c bad TX **D**,e bad	# SSP message sent on an external modem, radio, or direct connect.
13		Ext. Tx Bad	TERM: RX a/b,c bad TX d,**E** bad	# SSP messages which timed out and had to be retried on an external modem, radio, or direct connect.
14		Goes Tx Count	Goes Tx:	# Goes transmissions attempted.
15	A	Rom Checksum	ROM CheckSum:	EPROM Checksum
16	B	EEROM Fail Address	EEROM Write Error at xxxx	Address of bad byte in EEPROM chip.
17	C	Average Sample #	Recording Status: Averaging # n	Current sample# averaging
18	D	NMI Glitch Count	NMI Glitches:	Number of unexpected NMI signals
19	E	Analog Error Count	Analog Errors:	# analog A/D errors
20	F	Pressure Error Count	Pressure Errors:	# pressure A/D errors
21	G	A/D Timeout Count	A/D Retries:	# times A/D timed out and retried making a conversion
22	H	Reference Error Count	Reference Limits:	# times the A/D references were out of normal range.

Systat Field#	Tx Code	Field Name	Display Status Name	Description
23	I	Tx (Truncated) Count	Tx (Truncated):	# Goes Tx where the amount of data would had resulting in tripping the failsafe if it was not truncated by software
24	J	Basic Current Line Number	Basic Status: Running Line xxx	Current line number Tiny Basic is executing.
25	K	Basic Error Code	Basic Status: Last Error: **X** at line y	Last Basic error code: 0=Syntax Error,1=Math Error,2=Sensor Not Found,3=Line Number Not Found,4=Sensor Not Logged,5=Max MEM() Exceeded.
26	L	Basic Error Line Number	Basic Status: Last Error: x at line **Y**	Last Basic error line number
27	M	No Tx (Low Battery) Count	No Tx (Low Battery):	# Goes Tx skipped because the battery voltage was below 10.5 volts.
28	N	No Tx (Lock Detect) Count	No Tx (Lock Detect):	# Goes Tx skipped because the synthesizer would not lock on the channel.
29	O	No Tx (Goes Setup) Count	No Tx (Goes Setup):	# Goes Tx skipped due to a setup problem, such as: Group #'s not set in Alarm setup menu, international channel not in the range 1..33,domestic channel not in the range 1.99,101..199, Transmission too close to previous transmission (tx rate too small).
30	P	Goes Clock Error Count	Goes Clock Errors:	# of goes clock errors
31	Q	Tx (Started Late) Count	Tx (Started Late):	# Goes Tx allowed which started late
32	R	Tx (Low Battery) Count	Tx (Low Battery):	# Goes Tx allowed with low battery, battery below 8.5 volts (which indicates an A/D problem)
33	S	Tx (High Battery) Count	Tx (High Battery):	# Goes Tx allowed with high battery, battery above 14.9 (which indicates over-charging of the battery or an A/D problem)

The VTERM Sensor

Another special sensor is called VTERM, short for Virtual TERMinal. The Sutron Radio Terminal program (part of PC Base 2) sets value #0 in VTERM to send data to the "virtual terminal" and requests value #1 to read back screen displays. VTERM allows an 8200 terminal session to be simulated over an SSP reliable link.

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